

HANDBOOK

OF THE

4.5-IN. Q.F. HOWITZER.

LAND SERVICE.

1915.



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NOTE.

This book is corrected up to September, 1915. Any alterations which may be suggested should be forwarded direct to the Chief Inspector, Royal Arsenal, Woolwich.

HANDBOOK

OF THE

4.5-IN. Q.F. HOWITZER,

MARK I.

HOWITZER.

Material	...	Nickel steel.
Weight	of Howitzer with breech fittings...	8-cwt. 2-qrs. 20 lb.
(average)	of breech fittings	3-qrs. 16-lb.
Length, total	...	70 inches.
Bore	calibre	4.5 inches.
	length (to face of breech block)	60 inches - 13.33-calibres.
Capacity of cartridge case	...	43.88-cubic inches.
	system	Polygroove, plain section.
	length (approximate)	52 inches
	twist	Increasing from 1 in 41.314-calibres at breech end of rifling to 1 in 14.78-calibres at 5.87 inches from muzzle, remainder being uniform, 1 in 14.78-calibres.
Rifling	number of grooves	32.
Firing mechanism	...	Percussion, trip action.

HOWITZER BODY.

(Plate I.)

The howitzer consists of an "A" tube, jacket, and "B" hoop. The jacket is shrunk over the rear portion of the "A" tube, and is prolonged at the rear and prepared for the reception of a breech block. The jacket and "A" tube are secured longitudinally by means of corresponding shoulders, and the "B" hoop which is screwed and shrunk over portions of the "A" tube and jacket. The "B" hoop is prevented from turning when in position by means of a check screw in the front end.

A lug for attaching the howitzer to the hydraulic buffer of the carriage is provided on the under side of the jacket at the rear. A steel plunger with spiral spring, and retaining nut, are provided in the rear face of the lug for retaining the cylinder nut of the hydraulic buffer when in position.

Recesses are formed on each side of the jacket and "A" tube, provided with manganese bronze liners fitting the slides on the cradle of the carriage.

Lubricators, each consisting of a bronze nut with steel plunger and spring, are provided on each side of the "A" tube for use in lubricating the liners and slides.

A plane for clinometer is prepared on the upper side of the jacket at the rear.

The chamber is slightly coned throughout its length.

An axis line is cut at the breech on the left side. Vertical and horizontal lines are also cut on the muzzle and breech faces.

The actual weight of the howitzer is engraved on the top of the jacket.

The royal monogram is engraved on the upper side of the "A" tube in front of the "B" hoop. The nature, Mark, registered number, manufacturer's initials, and year of manufacture, are engraved on the upper portion of the breech end.

BREECH MECHANISM.

(Plate II.)

The mechanism is so arranged that by one pull on a lever the breech block is automatically withdrawn to the right, clear for loading. After loading, one thrust on the same lever slides the breech block home and closes the breech.

The names of the principal parts of the breech mechanism are shown on Plate II.

BREECH CLOSING MECHANISM.

Breech Block.—The breech of the howitzer is closed by a square hollowed steel block having a horizontal movement in a mortise cut completely through the jacket. The front face of the block is at right angles with the axis of the bore, while the rear face is slightly inclined. A cam groove is prepared in the upper side of the block for the reception of the cam plate of the breech mechanism lever by means of which the breech is opened and closed. The interior of the block is arranged for the reception of the striker, firing lever, and actuating pin. The rear face is fitted with a cover plate and retaining catch. The front face of the block is furnished with a firing hole bush with fixing screw, and has two projections for actuating the extractor. A steel pin for retaining the extractor in the howitzer is provided in the block.

Breech Mechanism Lever.—The lever is made of steel, and is pivoted in a recess formed in the upper right side of the jacket. The inner end of the lever is provided with a hard steel cam plate which engages the cam groove in the breech block. A retaining catch with flat spring, pivoted in the lever, engages with a recess in the jacket, when the breech is closed, and serves to retain the lever and breech block in the closed position. A steel block is formed on the interior of the handle portion at the upper end to form a stop, so as to limit the inward travel of the catch lever.

Extractor.—The extractor, which engages the rim of the cartridge case when in the gun, consists of a steel plate having two arms on the inner end. Two projections on the outer end engage with corresponding projections on the breech block, when opening the breech, and serve to actuate the extractor. A thumb piece is provided on the outer end to facilitate insertion into, and removal from, the howitzer. The extractor is retained in position by means of a retaining pin in the breech block.

FIRING MECHANISM.

The howitzer is fired by percussion through the agency of a striker which is fitted in the interior of the breech block. The striker is cocked and fired by a push on the handgrip of the trigger lever or by a pull on the lanyard attached thereto.

The howitzer cannot be fired until the breech is fully closed, as, owing to the sliding action of the breech block, the firing pin of the striker is not in line with the primer of the cartridge until the last movement of the breech mechanism lever in closing the breech.

Striker, Mark I.—The striker consists of a steel body with bush, firing pin and retaining nut, rebound collar, main spring, and striker guide. The bush, which is prepared for the reception of the firing pin and retaining nut, is screwed into the front end of the striker body and secured by a fixing screw. The rear end of the bush is prolonged and shaped to engage a bayonet joint in the striker guide. The rebound collar is furnished with two lugs which project through corresponding holes in the front end of the bush, when the collar is in position in the interior of the striker. The main spring is inserted behind the rebound collar in the striker, and is retained in initial compression by means of the striker guide which is pressed down and partially revolved so as to engage the projections on the rear end of the bush.

Mark II.—The Mark II striker is of a strengthened pattern, the rear portion of the body being of the same diameter as the front.

Firing Lever and Actuating Pin.—The firing lever is of steel, prepared for the reception of the actuating pin, and is arranged at the rear end of the striker. The lever is furnished at one end with a hinged pawl having a toe projection which engages a corresponding recess in the striker, the other end of the lever engages the rear face of the striker guide. The actuating pin passes through the centre of the firing lever, and is provided at the outer end with a flat head furnished with a featherway which engages a corresponding projection on the trigger bolt. The actuating pin is also used as a tool for dismantling the striker.

Trigger.—The trigger consists of a steel bolt, lever with lanyard, and spring keep pin. The trigger bolt is fitted through the upper part of the jacket, projecting into the mortise for breech block so as to engage the actuating pin of the firing lever when the breech is closed. The trigger lever with aluminium handgrip and lanyard fits over the bolt on top of the jacket projecting towards the left front with the handgrip towards the muzzle at an angle of 40 degrees to the axis of the howitzer and is secured by means of a spring keep pin. The lever is arranged for a push to the rear on the handgrip or a pull in the same direction by means of the lanyard. The handgrip portion is prepared on the front face with concentric grooves. A recess is cut in the collar of the trigger lever to engage the head of the safety stop in the "safe" position.

Safety Stop.—The safety stop consists of a steel bolt with spiral spring and adjustable head having two flat projections and hatched round the upper edge (later manufacture not hatched). The head is furnished with a pointer on one side, and is arranged so as to lock the trigger and prevent the howitzer being fired when the pointer

corresponds with the word "Safe" on the top of the jacket. The trigger is released when the head is turned so that the pointer corresponds with the word "Fire" on the jacket. A stop lug on the side of the head opposite the pointer serves to prevent the head being revolved beyond the safe position.

Action of Firing Mechanism.—The firing mechanism is so arranged that, when the breech is closed and the head of the safety stop turned so that the pointer corresponds with the word "Fire" on the jacket, the howitzer can be fired by a push on the trigger lever or pull on the lanyard attached thereto.

When the trigger lever is pushed or pulled, the trigger bolt, actuating pin, and firing lever are partially revolved, by means of which the striker with firing pin is forced to the rear and the striker guide to the front, compressing the main spring until the toe projection on the pawl of the firing lever slips past the recess in the striker, when the latter is free to go forward with momentum due to the energy stored up in the compressed main spring, and detonates the percussion primer of the cartridge.

The firing lever, actuating pin, and trigger are returned to the firing position by means of the main spring and striker guide.

The front end of the firing pin in the striker is withdrawn within the firing hole bush by means of the rebound collar in the striker, the projections on the front of which engage with the inner face of the firing hole bush.

REMOVING AND REPLACING THE BREECH FITTINGS.

To be removed in the order given.

Extractor.—Partially open the breech and withdraw the pin retaining extractor from the breech block. Close the breech and press the thumb piece of the extractor against the breech block. With the extractor in this position, fully open the breech and remove the extractor from the front face of the breech block.

Breech Mechanism Lever and Breech Block.—With the breech block in the loading position, withdraw the hinge pin of the breech mechanism lever and remove the lever and breech block.

Firing Lever and Striker.—Press in the plunger of the catch retaining cover plate, and slide the cover plate out of the breech block. Withdraw the actuating pin of the firing lever and remove the lever and striker.

Trigger.—Turn the spring keep pin to the rear as far as it will go by means of the thumb piece, and remove the trigger lever from the exterior, and the trigger bolt from the interior, of the howitzer.

Safety Stop.—Withdraw the head, and turn the stop to the left as far as it will go, and remove the stop.

TO REPLACE FITTINGS.

The fittings are replaced in the reverse order.

When replacing the extractor, the breech block must be in the loading position. Place the extractor in position on the front face of the block and close the breech, then press the thumb piece of the extractor towards the front away from the block as far as it will go, partially open the breech and insert the pin retaining extractor in the breech block.

CARRIAGE, FIELD, Q.F. 4.5-INCH HOWITZER, MARK I.

(Plates III and IV.)

The carriage is constructed to allow of 45 degrees elevation and 5 degrees depression being given to the howitzer. The howitzer when fired recoils axially in a cradle, the latter being fitted with an hydraulic buffer to limit the recoil, and running-out springs to return the howitzer to the firing position.

By special mechanism the length of recoil is automatically regulated according to the elevation; the approximate working recoil varies from 40 inches when the howitzer is horizontal to 20 inches when at 45 degrees of elevation.

The howitzer and cradle can be brought quickly from the firing to the loading position, and *vice-versa*, without using the elevating gear or disturbing the sighting arrangements.

The principal parts of the carriage are—trail, saddle, cradle, hydraulic buffer and running-out springs, elevating gear, cradle locking gear, cradle clamping gear, traversing gear, brake gear shield, axletree and wheels.

TRAIL.

The trail is formed with flanged steel sides connected by transoms, a tie bolt, and cover plates. The front end of the trail fits within the cranked portion of the axletree, and is secured to it by bolts through the sides.

A crosshead is fixed parallel to, and in front of, the axletree to form a bearing for the vertical pivot of the saddle.

A bronze guide is riveted to the upper portion of each side to clip the saddle shoes.

Brackets are provided to carry the traversing gear and portions of the brake gear.

Gunmetal bearing strips are fixed to the upper surface of the sides to form a sliding bed for the saddle during traversing.

A trail eye, spade, and lifting handles are provided at the rear end, together with a folding traversing lever, locking plates, and a compartment with a hinged lid for the sight carrier with leather case.

SADDLE.

The saddle consists principally of two side plates with trunnion brackets, the latter being provided with cap-squares. Each side is connected at the front by a steel plate to which is fixed a bearing for the pivot connecting it to the trail. The rear end of each side is fitted with a shoe which slides within a bronze guide on the trail during traversing. Brackets are attached to the left-hand side for the elevating and traversing gears.

CRADLE.

The cradle is a hollow U-shaped structure of steel, mounted on brackets with trunnions, by which it is pivoted to the saddle. It is formed with longitudinal guides on the top for the howitzer to slide on, and similar guides inside on which the head of the "compressor, running-out springs" slides. It is closed at the front end by a

detachable cap to which the piston rod is secured by a coupling, nut and pin.

A steel ring, of U-shaped section, is riveted to the rear end of the cradle; it is provided with a gunmetal bush through which the buffer cylinder passes, and forms a stop for the running-out springs; a howitzer stop, consisting of six leather rings, secured to a gunmetal ring, fits into the hollow of the U, and forms a cushion for the howitzer when running up.

HYDRAULIC BUFFER AND RUNNING-OUT SPRINGS.

(Plate V.)

The hydraulic buffer is contained within the cradle, and consists principally of a cylinder, stuffing box and gland, piston rod, piston, dividing collar, valves, carrier retarding valve, securing nut and pin.

The cylinder is secured to the howitzer and moves with it, the piston rod remaining stationary. The recoil and running-out is controlled by the flow of the liquid through ports in the piston, the ports being gradually closed automatically by valves, one at each end of the ports in the piston. The rear end of the cylinder is closed by a steel plug which is provided with two smaller plugged holes for emptying and filling. The front end is closed by the stuffing box and gland. A number of spiral grooves are formed inside the cylinder which engage with guides formed on the outside of the piston, and cause the piston to rotate on the piston rod.

The stuffing box is formed to contain a leather ring of U-shaped section, and an asbestos packing ring, which are retained in shape and position by rings of phosphor bronze. The asbestos ring is pressed round the piston rod by the screwing action of the gland and the U-leather by the admission of liquid to the centre of the ring through small longitudinal holes in the rear of the stuffing box. The gland is retained in position by a stop secured to the head of the compressor.

The Piston-rod.—The front end of the piston rod is secured by a nut and pin to a coupling, which is capable of being turned within the front cap; to the rear end is attached the piston and valves. A recess is cut around the rod near its rear end to take a dividing collar in two halves. The use of the collar is to limit the rear movement of the recoil valve to prevent the latter seizing against the face of the piston, on recoil.

The piston is formed with longitudinal guides which fit in the spiral grooves in the cylinder, and is free to turn on the piston rod. Four openings are cut through the piston from front to rear for the passage of the liquid.

The valves—"retarding" and "recoil"—are bronze rings fitting over the piston rod and having openings approximating to those in the piston. The recoil valve which is feathered to the piston rod acts against the front face of the piston and controls the recoil, and the retarding valve which is feathered to a steel carrier in turn feathered to the piston rod against the rear face of the piston and controls the running up. They are capable of a small longitudinal motion on the piston rod, but are prevented from turning independently of the piston rod by the feathers and featherways.

The Cam, actuating Recoil Valve. (Plate VI).—An arrangement for automatically reducing the recoil as the elevation increases is provided. It consists principally of a cam, bar, lever, rod, an arc, and a toothed collar.

The cam groove is cut in a bracket secured to the right-hand capsquare, and actuates the vertical bar. One end of the bar is provided with a roller which works in the cam groove, and the lower end, to which is attached a short lever, engages with a short crank on the rear end of the rod which is supported longitudinally within the cradle; to the front end of the rod is fixed the toothed arc, the teeth of which engage with the toothed collar; the latter is screwed and keyed to the piston rod coupling, which is secured to the front end of the piston rod.

As the cradle is elevated, all the gear, except the cam, moves, and the cam is so formed that it draws the bar upwards; the motion is transmitted through the lever, rod, arc, toothed collar, and coupling to the piston rod and valves, which are thus given a small rotary motion, and alters the relative position of the valves to the piston, reduces the area of the passages for the liquid, and causes the recoil to be shortened.

Running-out Springs.—The running-out springs are three in number, two wound left and one right. They envelop the buffer, and are held in initial compression between the rear cradle cap and the head of a bronze compressor which is screwed on the exterior of the cylinder.

The compressor is also used for initially compressing the springs when assembling them on the buffer cylinder. It is formed with a head to slide on the guides in the cradle during recoil and running-out.

Action of Buffer and Running-out Springs.—When the howitzer is fired, the buffer cylinder is drawn to the rear (the piston rod remaining stationary), and the running-out springs further compressed. The effort of the liquid to pass from the front to the rear of the piston presses the recoil valve against the front face of the piston except for the small clearance allowed by the dividing collar and forces the retarding valve towards the rear. During recoil the liquid in front of the piston passes through the openings in the recoil valve and piston. At the commencement of the recoil, the ports in the piston are uncovered by the recoil valve, but as the recoil proceeds the piston is caused to revolve on the piston rod by the grooves in the cylinder, whilst the valves, which are feathered to the piston rod, remain stationary, thus causing the ports in the piston to be gradually closed by the recoil valve, and absorb the energy of recoil. During the recoil, the running-out springs have been further compressed, and at the completion of the recoil their expansion returns the howitzer and cylinder to the firing position. At the same time, the liquid is forced from the rear to the front of the piston, and causes the recoil valve to move away from the face of the piston, and presses the retarding valve against the opposite face of the piston; the piston is rotated by the grooves in the cylinder, which causes the ports in the piston to be gradually closed by the retarding valve, and thus bring the howitzer to rest at the firing position.

NOTE.—On the outside of the front cap of the cradle is a small scale, graduated in degrees. There is an index arrow on the piston

rod coupling. The readings on this scale correspond approximately with the elevation of the howitzer when the actuating gear is properly assembled, if the carriage is on a level platform and the spade buried.

The piston rod nut has a vertical line cut in it to indicate the position in which the rod must be kept when pushing it home after filling the buffer.

ELEVATING GEAR.

(Plate VII.)

The elevating gear is attached to the left side of the saddle, and consists principally of a worm and wormwheel contained within a bracket, and actuated by a handwheel and two arcs pivoted to the cradle trunnions.

The thrust of the worm is absorbed by a collar, spring discs and a screwed bearing or nut in front of the bracket; this arrangement also provides a means of adjustment to take up the backlash due to wear.

The wormwheel is mounted on a transverse shaft having two pinions of the same diameter, each of which engages with a toothed arc.

Each arc is formed with an arm, on the end of which is a hollow concentric bearing which fits over the trunnions of the cradle, and rests in the trunnion bearing of the saddle.

A bracket is fixed to the bearing of the left-hand arc for the attachment of the sights.

CRADLE LOCKING GEAR.

(Plate VII.)

The cradle is connected to, or detached from, the arcs of the elevating gear by the cradle locking gear. The gear is mounted on the rear end of the cradle, and consists principally of a series of levers and links which are pivoted to suitable brackets, and actuate spring plungers.

The plungers are formed to engage with the elevating arcs, and are retained in position by springs; they are withdrawn from the arcs by a hand lever which engages with a roller on the right-hand cranked lever.

Action of Locking Gear.—By raising the hand lever, the plungers are withdrawn from the elevating arcs, and the cradle is disengaged from the elevating gear; the howitzer with its cradle is then free to be brought quickly from the firing to the loading position (horizontal) and *vice-versa*, without disturbing the sights, or the elevating gear.

When returning the cradle to the firing position, the plungers automatically engage with the arcs. The arcs should be disengaged from the plungers when housed.

CRADLE CLAMPING GEAR.

This gear is provided to clamp the cradle to the trail in the travelling position and consists of a Λ -shaped clamp pivoted at its lower ends in bearings secured to the trail, and provided at its upper end with a pawl which engages with a bracket on the underside of the cradle. When travelling the clamp is engaged with the cradle by the pawl, in other circumstances the clamp is disengaged and swung clear of the cradle.

In order to secure the cradle for travelling, the clamp (which hangs down when not in use) is raised to a vertical position, and the cradle is lowered to meet it by hand pressure after releasing the plunger from the arcs of the elevating gear, when the pawl engages in the bracket.

A white line is painted on the carriage to indicate when the cradle is at the correct elevation for clamping.

TRAVERSING GEAR.

(Plate VII.)

The howitzer may be traversed through an angle of three degrees right, and three degrees left, by a nut and a screw actuated by a handwheel on the left side of the carriage. The nut is swivelled to a bracket on the saddle, and the screw to a bracket fixed to the trail.

The angle of traverse is indicated by a pointer on a degree scale plate.

BRAKE GEAR.

The tire brake, which acts on the wheels, is for use when firing or travelling, and consists principally of two brake arms actuating rods and levers.

The brake arms are pivoted at one end to the trail, and provided at the other end with a Service cast-iron brake block which acts on the wheels.

Each arm is connected by a rod to a short lever mounted on an axis pin. The axis pins work within brackets bolted to the cheeks of the axletree, and are connected to each other by a short lever and a connecting rod which passes through the cranked portion of the axletree.

The right hand actuating rod is screwed for a portion of its length, and provided with a nut which is prevented from turning by forks on the lever; two handles are fitted to the screw so that the gear may be actuated from the front or the rear of the carriage.

A quick release arrangement is fitted to the brake gear, which enables the brake to be quickly applied or released by means of a lever and an eccentric on the left side of the carriage at the rear of the shield.

A plate is fitted to the nut actuating screw, to prevent the ingress of grit to the screw.

SHIELD.

The shield is fixed in front of the axletree, and is secured to it by four brackets, and supported by stays which fit in sockets formed in brackets on the front of the trail. The upper portion is hinged to fold, and is secured in the "up" or "down" positions by sliding bolts.

A hood is provided to protect the dial sight and its carrier, and a shutter to cover the opening used with the bar sight.

The two outside brackets connecting the shield to the axletree are each formed with a recess for the reception of a dust excluder, which consists of an L-shaped leather ring which is secured by a steel plate; the L-leather envelops the inner end of the pipe box, and prevents the ingress of dirt, dust, &c.

Leather cases and fittings are provided on the shield for carrying the dial sight, clinometer, spare part case, breech and muzzle covers, and drag ropes.

The upper portion of the shield is lowered when travelling, and when using the dial sight for laying back at certain angles. The dial sight may foul the upper portion of the shield under certain conditions but not in any possible firing position.†

AXLETREE AND WHEELS.

Axletree.—The axletree (2nd class "C" No. 34) is a cranked tubular steel forging with arms for the wheels; the front end of the trail fits within the cranked portion, and is secured to the cheeks by bolts. The outer end of each arm is fitted for a linch pin and an adjusting collar, which has a number of recesses (through which the linch pin passes) cut in one face; the recesses are of varying depths, from 2 inch to 5 inch, increasing by .05 inch, so that any reduction in the length of the pipe box, due to wear, may be adjusted.

Wheels.—The wheels are 2nd Class "C" No. 45, 4 ft. 8 in. diameter, with steel flanges, removable phosphor bronze pipe box, and a 3-inch steel tire with rounded edges.

The nave consists of two flanges of corrugated steel, which are connected by bolts. The inner flange is fitted with a steel ring to strengthen it, and the outer flange with a centring ring. The pipe box passes through the centre of the flanges, and is secured by a nut, which is prevented from working loose by a flat spring which is fixed to the outer flange and engages with one of a number of ratchet teeth on the rim of the nut. For future manufacture the spring and ratchet teeth will be replaced by a locking plate, which fits over the octagonal nut, and has two arms through which it is bolted to the flange, the existing nave bolts being used for this purpose.

A dust cap is screwed on the outer end of the pipe box; it encloses the adjusting collar, linch pin, and the end of the axletree arm. The inner face of the cap is recessed for the reception of a corresponding projecting ring on the nut, the cap being secured to the nut by a split keep pin.

The pipe box is provided with a lubricating hole, which is closed with a $\frac{1}{4}$ -inch screw.

The drag washer is free to revolve round the nut, and is secured by the dust cap.

On an emergency, a 2nd class "C" No. 200 wheel may be used to replace a No. 45 wheel, in which case the adjusting collar and linch pin for capped wheels may be used, the linch pin being secured by a piece of wire or a leather lace. In place of the adjusting collar and linch pin, the ordinary 2nd class drag washer and linch pin can, if desired, be used.

When using No. 200 wheels which have not had the inner flange reduced in diameter, the dust excluder (L-leather with keep plate) must first be removed.

† It will foul if the traversing gear is at one degree or more left traverse, howitzer elevated to 25 degrees, dial sight carrier set at 45 degrees, and adjusted to full extent for left wheel high.

Tool Case.—A leather tool case, for spanners and tools, is carried on a bracket on the front end of the trail.

For positions of the various stores carried on the carriage, see Packing Diagram, page 54.

SIGHTING.

The howitzer is provided with the following sighting arrangements:—

Sight, bar.

Sight, dial, No. 7.

Carrier, No. 7 dial sight, No. 1.

Sight, dial, No. 1 (with adapter).

The bar sight is fitted to the left elevating arc of the carriage.

When in use the No. 7 dial sight fits in the No. 1 carrier, the latter being attached to the left side of the cradle. When not in use the dial sight and carrier, contained in cases, are carried on the shield and in the trail, respectively.

SIGHT, BAR.

(Plate VIII.)

The bar sight consists of a steel arm with fore and hind sights and automatic clamp, attached by studs to the supporting bracket on the left arc of the elevating gear of the carriage.

The arm is furnished at the front end with an acorn-pointed foresight with clamping screw. A brass cap with chain and loops for protecting the foresight when not in use is attached to the arm.

The rear end of the arm is furnished with a hindsight and automatic clamp. The hindsight consists of a curved sight bar having an elevation scale strip on the left side, graduated in yards up to 3,200, for 4th charge. The sight is provided with a half cross-head furnished with a deflection nut, and traversing screw with milled head; the crosshead is provided with two scale plates graduated to 5 degrees right and left respectively for deflection, and an arrow plate is attached to the rear face of the deflection nut to indicate the scale.

The sight bar is provided with a rack on the rear face gearing with the pinion of the automatic clamp. The clamp is provided with a milled head as a means of adjusting the sight bar, and with an arrow plate to indicate the scale on the sight bar.

For quick setting the clamp is drawn down, thereby disengaging the pinion from the rack when the sight can be raised by hand. When set, the pinion is forced to engage by a spring which is contained in the bearing for the pinion spindle.

The sight and clamp are set at an angle of 4 degrees to compensate for drift.

SIGHT, DIAL, NO. 7 AND CARRIER, NO. 7 DIAL SIGHT, NO. 1.

The No. 7 dial sight is employed for both direct and indirect laying. The upper part of the sight can be revolved through a

complete circle independently of the eyepiece, thereby allowing the layer to see objects in any direction without moving the position of his eye. Owing to the height of the sight the layer can lay on objects directly behind him, the line of sight being above his head. A coned seating in the sight rests on a coned projection on the carrier, and the sight is held down to the carrier by means of a spring catch in the latter which engages a nut on the lower end of the sight. The nut is castellated, and its position can be adjusted so that the sight has no movement in the carrier. A projection on the sight fitting into a recess on the carrier prevents the sight revolving.

The No. 1 carrier is clamped to the cradle of the carriage so as to move with it when the elevating gear of the carriage is worked. It is provided with a reciprocating arrangement to compensate for difference in level of the carriage wheels, and is automatically adjusted for correction for drift, corresponding with the elevation indicated on the elevation scale drum. It is provided with arrangements for indicating as follows:—

Angle of elevation—By elevation scale drum and longitudinal level.

Angle of sight—Independently of the elevation.

Angles of deflection.

SIGHT, DIAL, No. 7.

(Plates IX and X.)

MARK II.—The optical arrangements are so designed that an object viewed through the sight is always seen erect. They consist of—

- F. The *upper prism*, which is mounted in the upper portion of the sight. Its face can be turned in any direction with reference to the eyepiece K; the angle between the two being indicated on the dial plate A by means of a reader on the bracket N.
- G. The *centre prism*, which by means of level gearing is made to revolve at half the speed of the upper prism F. This arrangement ensures the object layed on always appearing erect.
- H. A double reflecting roof prism.
- J. The object glass.
- K. The eyepiece, with two eyelenses.
- M. A glass diaphragm, upon which are engraved vertical and horizontal lines with gaps near their centres.

A glass window in the eyepiece allows of their being illuminated with a lantern at night.

The magnification of the system is four diameters and the field of view is ten degrees. There are no arrangements for focussing the sight.

The principal mechanical parts are the following:—

- B. The *supporting pillar*, in which are suitably mounted the eyepiece K fitted with a dermatine eyeguard, the lower prism H and the object glass J. The "plug, supporting pillar" V is screwed into its lower end, and on it is a

castellated nut, which is prevented from unscrewing by a split pin. Near the upper end of the supporting pillar is a coned seating W, which fits accurately on to a coned bearing on the carrier. The projection X which fits into a slot in the carrier prevents the sight revolving.

- C. *The worm wheel bracket* is firmly secured to the supporting pillar B. In it is mounted the slow motion traversing gear, which consists principally of a worm spindle S, the worm on which engages with the worm wheel D. On either end of the spindle is mounted a milled head and an adjustable micrometer scale drum. The drums are graduated in opposite directions in divisions of ten minutes. The graduations on the *Right* drum are filled in with a *white* metal on a black background and those on the left are filled in with black on a brass background. The drums can be adjusted by loosening the caps inside the milled heads with a special wrench, and turning them independently of the milled heads. The readers for the drums are on the worm wheel bracket. Each turn of the worm spindle moves the upper part of the sight through five degrees. The worm spindle is mounted in an eccentric, which when turned by raising a lever near the left drum throws the worm out of gear with the worm wheel. This enables the upper part of the sight to be revolved rapidly. The rear surface and four screws are only made use of when the sight is being used with the Nos. 2, 4, or 5 carriers.
- D. *The worm wheel* has teeth, which engage with the worm spindle S, cut on its lower portion. It extends upwards and is firmly secured to the upper prism holder E and the dial plate A by screws, &c.
- Y. *The centre prism holder* fits accurately in the supporting pillar B. To it is attached the prism mount P, in which the centre prism G is firmly held.
- The prism holder is free to revolve, and is forced to do so at half the speed of the upper prism holder E, by means of three bevel wheels. The axis of the vertical bevel wheel Z is formed on a projection from the prism holder. This wheel engages with the lower bevel wheel Z¹, which is fixed to the supporting pillar, and also with the upper bevel wheel Z², which is fixed to the upper part of the sight. When the upper part of the sight is revolved the axis of the centre bevel wheel, and consequently the central prism, are forced to revolve at half the speed of the upper part of the sight.
- E. *The upper prism holder*, as previously mentioned, is rigidly attached to the dial plate and worm wheel. In it are suitably mounted the upper prism and a glass window. To enable the line of sight through the upper prism to be elevated or depressed a small toothed arc is attached to the mount of the prism. The teeth of this arc engage with a worm spindle R. At the top of this spindle are mounted a milled head and an adjustable drum, engraved with a zero mark. The reader

is engraved on the prism holder; 17° elevation or depression can be given.

A crosshead with open sights (or view finder) is mounted on the right side of the upper prism holder. Its movement is regulated by that of the upper prism, but as the latter has a reflecting surface the former has to move twice as quickly. This is arranged for by a toothed wheel on the prism mount gearing with a toothed wheel, having only half the number of teeth, on the pivot of the crosshead with open sights.

Engraved on the under portion of the crosshead is a zero mark, indicated by an arrow on the upper prism holder.

- A. *The dial plate*, as previously mentioned, is firmly fixed to the worm wheel and upper prism holder. Two scales, each reading from 0 to 180 in single degrees, are engraved round the dial plate. The *right* graduations are filled in with *white* metal on a black background, and the left scales with black on brass. The scales are read by a reader on the reader bracket N. This reader can be adjusted by loosening two screws in its rear surface and moving it to one side.

MARK I.—The Mark I sight differs from the Mark II in the following particulars:—

One of the milled heads on the worm spindle is smaller.

A vertical scale, with graduations to 15° elevation and depression is fixed to the upper prism holder, and the micrometer scale drum is graduated in intervals of 10 minutes.

Certain internal parts are of steel instead of bronze.

Mark I sights are brought up to Mark II type when passing through Woolwich for repair.

CASE, No. 7 DIAL SIGHT, No. 1.

A stout leather case with internal cork fittings is provided. It holds the sight in a vertical position, and is attached to the shield on the carriage.

It is suitable for either the Mark I or Mark II sight, except that the fittings which press against the milled heads of the traversing gear must be reduced in thickness when used for a sight with the longer pattern milled heads.

Care must be taken when removing the sight from its case that no strain is put on the dial plate.

CARRIER, No. 7 DIAL SIGHT, No. 1.

(Plate XI.)

The No. 1 Carrier for No. 7 dial sight consists of reciprocating, elevating arc, elevating, deflection, and sight socket, brackets, and is clamped to the supporting bracket on the carriage by means of a clamping screw and handle.

The reciprocating bracket is provided with the clamping screw

and handle for securing the carrier in position on the carriage, and with the hinge stud on which the elevating arc bracket is pivoted so as to admit of oscillation of the latter to 8 degrees right and left, to compensate for difference in level of wheels of the carriage.

The elevating arc bracket is pivoted on the hinge stud of the reciprocating bracket, which is parallel to the longitudinal axis of the howitzer. It is provided at the lower end with a cross level, trunnion nut and bearing, and adjusting screw with milled head for levelling. Two trunnion screws, arranged at right angles to the hinge stud of the reciprocating bracket, are also provided for the attachment of the elevating bracket.

The elevating bracket is pivoted to the elevating arc bracket by means of the two trunnion screws mentioned above, and is furnished with worm, worm spindle, elevation scale drum graduated in yards for 4th charge, arrow ring, handwheel and arrow plate. The bracket is actuated round the axis of the trunnion screws by means of the worm gearing with the segmental arc rack on the elevating arc bracket. A sight clinometer with elevation and depression scale plates each graduated to 10 degrees, and actuating screw with two milled heads each supporting a micrometer scale drum graduated in 5 minute divisions, is provided on the left side of the bracket. The actuating screw is supported at one end by a bearing block, and at the other end by a bearing spring, so arranged as to admit of the screw being pressed down clear of the worm rack to facilitate quick setting of the clinometer. A vertical pivot bolt is provided in the front end of the bracket for the reception of the deflection and sight socket brackets. On the upper side of the bracket is a cam with bevel wheel actuated by a pinion on the worm spindle. The cam engages a friction roller on the deflection bracket, when the elevation scale drum is revolved in setting on the elevation, and automatically turns the deflection bracket to the angle for correction of drift corresponding with the elevation. A steel plunger with spiral spring is provided in a lug on the elevating bracket, the inner end of which engages a projection on the deflection bracket and serves to return the latter to the zero position when the elevation scale drum is turned to zero.

The deflection bracket is pivoted on the pivot bolt in the front end of the elevating bracket, and is automatically adjusted for drift as described above. The rear face of the bracket is provided with a traversing screw in two parts and two milled heads having right and left deflection drums, respectively, graduated in 5 minute divisions, and with right and left deflection scale plates each graduated to 5 degrees.

The sight socket bracket is pivoted on the pivot bolt on top of the deflection bracket, and is secured in position by a nut and keep pin. The bracket is furnished on the under side with a worm rack gearing with the traversing screw of the deflection bracket and on the rear with an arc with indicating arrow for use with the deflection scale plates on the latter. A socket for the reception of the No. 7 dial sight is formed at the rear end of the bracket, and is provided at the lower end with a catch pin for securing the sight in position.

The sight clinometer and cross levels are provided with reflectors so that the position of the bubbles may be observed below the height of the levels.

The marking on the scale plates and micrometer heads will be white on black ground for right, and black on brass ground for left.

A leather case for No. 1 carrier is provided. Before placing the carrier in its case, all arrow plates should be set at zero to ensure its being correctly housed.

Care and Preservation of Dial Sight and Carrier.—See "Regulations for Magazines and Care of War Matériel."

SIGHT, DIAL, NO. 1, MARKS I* AND II.

The dial sight consists of a circular carrying plate with degree scale ring, a crosshead and pin, and a sight plate with pointer. The carrying plate is hinged at the centre to the crosshead, and the crosshead is hinged transversely to the crosshead pin. This arrangement admits of an adjustment right and left to compensate for any difference that may occur in level of the wheels, and for elevation or depression being given to the plate and sight. The degree scale ring is fixed to the periphery of the carrying plate by screws; it is marked in degrees, 180 on each side of zero, the required angle being read by means of a pointer fixed to the rear end of the sight plate. Should it be found by examination that when the sight line and axis of the gun are parallel, 0 degrees is not indicated, the pointer is so formed as to admit of the required adjustment being made. The sight plate is pivoted to the centre of the carrying plate and jointed near its centre; the joint pin is provided with a thumb nut for clamping the plate in the extended or folded position; the plate is fitted with an acorn-pointed foresight at the front end, and notched to form a hind sight at the rear end. A clamping screw is provided to fix the sight plate at the required angle. The sight is fixed to the bracket by the crosshead pin, which fits into a corresponding socket in the adapter, and is secured by a keep pin.

ADAPTER, NO. 1 DIAL SIGHT, Q.F., 4.5-INCH HOWITZER (MARK I).

The adapter is necessary to enable the No. 1 dial sight to be used with the "Carrier, No. 7 dial sight, No. 1." It consists of a steel socket prepared at the upper end to receive the stem and securing pin of the No. 1 dial sight. The exterior and lower end is shaped to fit the No. 1 carrier to which it is secured by means of the catch pin of the latter.

INSTRUCTIONS FOR TESTING AND ADJUSTING THE SIGHTS.

Any adjustment required to optical instruments must be carried out by an Armament Artificer.

Before any of the following operations are carried out, the carriage should be placed on a firm platform, or on hard level ground, and manipulated until the howitzer is level both longitudinally and transversely.

NOTE.—The No. 1 dial sight and adapter are emergency issues, pending the supply of sufficient No. 7 dial sights.

CARRIER, No. 7 DIAL SIGHT, No. 1.

(1) The bubble of the cross level should be in the centre of its run when the top of the carrier is level transversely.

Test.—Place a Mark III or IV Field Clinometer, set at zero, across the "Disc, testing dial sight carrier," which is placed in position in the carrier in a similar manner to the sight, and bring the bubble of the clinometer in the centre of its run by the cross levelling gear. The cross level should now be in the centre of its run, if not it should be adjusted.

Adjustment.—Slacken the fixing screw of the crosshead case on the left side, raise or lower the case till bubble is central, then re-tighten fixing screw.

(2) With the gun laid horizontal, and top of carrier levelled horizontally and longitudinally, the elevation scale should indicate zero, and the bubble of sight clinometer should be in the centre of its run with its scales reading zero.

Test.—Lay gun horizontal by placing a Mark III or IV Field Clinometer set at zero on clinometer plane of gun and work the elevating gear of latter till the bubble is in the centre of its run.

Then place the clinometer longitudinally upon the top of the "Disc, testing," set the sight clinometer at zero, and bring the bubble of the Field Clinometer central by the elevation scale drum. The latter should now read zero, and bubble of sight clinometer should be central, if not, adjust as follows:—

ADJUSTMENT.

Elevation scale drum.—Slacken the nut securing handwheel, pull the wheel down till its teeth are clear of those on drum, then holding the wheel firmly to prevent its turning, revolve the drum to zero, re-engage teeth and tighten up the securing nut.

Sight clinometer.—Revolve the milled heads till bubble is central, slacken the nuts securing micrometer scales and the screws securing reader of degree scale, set the micrometer scales and reader at zero, and re-tighten nuts and screws.

ALIGNMENT.

SIGHT, DIAL, No. 7, AND CARRIER, No. 7 DIAL SIGHT, No. 1.

Obtain a line of sight along the axis of the bore by stretching fine cords across the vertical and horizontal lines at the muzzle, and use the striker hole in the breech block as a sighting hole (having first removed the striker bush and cover plate). Lay the intersection of the cross lines on a well defined object at least 1,000 yards distant.

Place the dial sight in position in its carrier and set all scales on sight and carrier, at zero. Then on looking through the sight it should be on the distant point both for elevation and direction, if not, adjust as follows:—

Elevation.—Revolve the milled head actuating upper prism holder till sight is on, then slacken the clamping cap of the micrometer scale

and turn the scale to zero without turning the milled head and re-clamp.

The arrow on the side will not be quite opposite zero and, if necessary, it should be re-engraved.

Direction.—Revolve the gear actuating dial plate till sight is on, slacken the nuts securing micrometer scales and screws of reader for degree scale, set scales and reader to indicate zero and re-clamp.

CROSSHEAD, NO. 7 DIAL SIGHT.

Direction and Elevation.—Set the elevation and deflection scales, the upper prism graduated drum and the cross-head at zero. The line of sight of the cross-head should fall on (D).

Adjustment.—Slight errors should be noted, no adjustment being provided.

The adjustments to carrier, however, should not be disturbed or altered, unless the tests have been most carefully carried out, and repeated tests with another dial sight have shown an error. If the error is greater than 30 minutes the dial sight should be replaced by another, and returned to Woolwich for correction.

SIGHT, BAR.

Lay the bore on the distant point as with No. 7 dial sight, set elevation and deflection scales at zero. Line of sight through bar sight should fall on the same distant point both for elevation and direction, if not, adjust as follows:—

Elevation.—Slacken the lock nut of the foresight and screw the latter up or down till line of sight is on, then re-clamp lock nut.

Direction.—Bring the sight on by the deflection gear, slacken the securing screws of the arrow plate, shift the plate to zero and re-clamp.

Note.—Should no distant point be available, a target should be constructed as shown in Plate XII which should be set up about 50 yards in front of the muzzle.

Then with the bore laid on "B," telescope of dial sight should be adjusted on "T," crosshead on "D," and Bar Sight on "O."

NO. 7 DIAL SIGHT ON 4.5-INCH Q.F. HOWITZER CARRIAGE.

Inaccuracy due to wear in the drift cam.

Experience has shown that wear in the drift cam of the No. 1 Carrier for No. 7 dial sight on 4.5-inch Howitzer carriages is liable to cause inaccuracy in the sight.

The following test should be carried out:—

Level the carriage so that there be no difference in level of wheels.

A distant point should be laid on through the telescope with the range gear at zero.

A range should then be put on the drum and the horizontal crosswire of the telescope brought on to the same distant point by means of the elevating gear.

The vertical crosswire should now be brought on to the same distant point by means of the deflection gear.

The amount of deflection shown on the sight should agree with that given in the accompanying table as deviation due to drift.

TABLE OF RANGE AND DRIFT.

Range in Yards.	Angle of Deviation.	
	Dega.	Min.
1,000	—	9
1,500	—	15
2,000	—	21
2,500	—	29
3,000	—	38
3,500	—	61
4,000	1	8
4,500	1	31
5,000	2	16
5,100	2	28
5,200	2	42
5,300	3	6
5,397	3	39

Check tests should be taken at at least 5 ranges between these limits.

If the arithmetical sum of the two maximum differences from the correct deviation exceeds 15 minutes or if any individual error exceeds ten minutes the cam should be exchanged.

LIMBERS AND WAGONS.

LIMBER, CARRIAGE, Q.F., 4.5-INCH HOWITZEE MARK I.

(Plates XIII and XIV.)

The limber is constructed to carry the ammunition in baskets. The limber and draught hooks are provided with springs which are intended to ease the strain of draught upon the horses, particularly at starting. The trail of the carriage and perch eye of the wagon are secured in the limber hook by a catch instead of the usual form of key.

The limber consists principally of a steel frame, a limber hook ammunition box, draught fittings, axletree, and two field wheels.

FRAME.

The frame consists of four futchels connected by stays and provided with flanges by which the axletree is secured. The outside flanges are fitted with dust excluders, similar to those on the carriage,

and the outer ends of the frame are provided with manganese bronze brackets for the application of the lifting jack.

To the front end of the futchels are fixed foot and platform boards.

A hollow rectangular-shaped bronze bracket for the limber hook is secured between the two inner futchels at the rear.

A draught hook is fitted to the front end of each outer futchel. Its shank is provided with a spring and compressor screw which are contained within a cylindrical steel case riveted to the outer futchel and secured therein by a cap with a screw and keep pin.

A prop is attached to the rear, which, when not in use, is secured by a spring clip.

LIMBER HOOK.

The limber hook (No. 29, Mark II) is a steel forging, formed with a hollow cylindrical extension (with flat tops and bottom), which works in guides formed in the bracket.

A steel spring is mounted on the outside of a tubular case, and contained within the hook; riveted to the inside of the case is a cup-shaped nut which is formed with a square socket for the nib of the draught pole, and threaded centrally for a compressing screw for obtaining and removing the initial compression on the spring.

The case and spring are secured within the hook by a guide ring threaded externally, and the hook is secured within the bracket by a ring-shaped nut held by a split spring keep pin.

A catch, which is mounted on the spindle portion of a handle, is hinged within the hook, and retains the trail of the carriage when limbered up. The handle is for use when unlimbering; the catch is retained in the closed position by means of springs, one on each side.

Action of Limber Hook.—In limbering up, the catch is depressed by the pressure of the trail eye; when the eye has passed the catch, the latter automatically returns to its normal or closed position by the action of the springs. To unlimber, the handle of the catch is pushed forward by hand until the trail eye can be disengaged from the hook.

AMMUNITION BOX.

The ammunition box is fixed to the futchels, and further supported by two vertical flanged plates which are fixed to the outer futchels and the box, and constructed to carry twelve rounds, 2 Shrapnel and 10 H.E. shell.

It is provided with detachable guard irons, rifle clips, and hand straps; the top of the box has a leather covered cushion.

It is closed at the rear by a lid which is hinged at the bottom, and secured when closed by a lock and a spring hand catch at each side. A chain at each side supports the lid when open.

A "turnscrew, shell plug" for the fuze hole plug in the projectiles is fitted to the box at the rear of the off side.

The interior is divided into eight compartments, six of which contain removable cane ammunition baskets. Each basket contains two complete rounds of ammunition, and is provided with a protecting cover of felt. The baskets should not be used as carriers. Two trays for holding small stores, distinguished as No. 1 and No. 2, are carried in compartments.

Baskets for blank cartridges are provided. The basket is similar to that provided for Service ammunition with the exception that the wood fittings will hold ten blank cartridges. The ends are painted blue to distinguish them from the Service pattern. Two per sub-section are issued and will be carried in the recess in the ammunition boxes provided for Service ammunition baskets, the latter being removed as required when blank is ordered to be carried.

DRAUGHT FITTINGS.

The fittings for draught consist of a No. 17 Mark III pole, a No. 3 supporting bar, and two No. 11 singletrees. The pole and bar are for use with the R.A. pole draught breast harness.

The pole is 12-feet 4½-inches in length over all; the front end is protected by steel wrapping plates; a U-shaped tug is passed through the pole from the under side, and secured by a nut on the top. The tug forms a stop for the pole bar, and its position from the point of the pole may be varied from 14½-inches to 29½-inches, in distances of 3-inches, according to requirements.

The pole bar is 3-feet 9½-inches in length, fitted at the centre with a loop, which is formed to pass over the front end of the pole and butt against the tug. Two links are fitted on each side of the loop, by means of which the bar is attached to the neck piece of the harness. The singletrees are 2-feet 6-inches long.

AXLETREE AND WHEELS.

Axletree.—The axletree (No. 196) is a tubular steel forging with second class axle arms; it is secured to the frame by the flanges, and prevented from turning by a feather in the outer flange; the linch pin and adjusting collar are the same as for the carriage axletree.

The wheels are the same as those described for the carriage.

The limber is fitted on the underside with wire net receptacles for carrying canvas water buckets, with fittings to carry a 3-lb. grease tin, and two No. 3 lubricating cans (one for Rangoon, and one for buffer oil), and the various stores as shown on packing diagram, page 54.

Half the limbers per battery are fitted with loops for kicking straps.

LIMBER, WAGON, Q.F., 4½-INCH HOWITZER, MARK I.

(*Plates XIII and XIV.*)

The wagon limber differs from the carriage limber in the number of rounds carried, viz., 4 Shrapnel and 12 H.E. Eight ammunition baskets are provided, but no tray for small stores. Baskets to contain H.E. projectiles are coloured yellow, and they are now being arranged to carry the shell fuze.

WAGON, AMMUNITION, Q.F., 4.5-INCH HOWITZER, MARK I.

(Plates XV and XVI)

The wagon consists principally of a steel frame, a hollow box perch fitted with a perch eye, a perch hook, a steel ammunition box, a brake gear, a 2nd class axletree, and two field wheels.

A distinctive feature of the wagon is the provision of a perch hook at the rear, so that two or more wagons may be coupled in series, or the wagon may be used to take a howitzer with its carriage on an emergency.

FRAME

The frame consists of two flanged sides of steel plate connected by stays; the perch is continued to the rear end of the frame, and is fitted at the front end with a No. 17 perch eye and at the rear end with a No. 1 perch hook which is fitted with a retaining catch, the action of which is similar to that of the limber hook described on page 24; platform and foot boards are fitted to the front ends of the sides and the perch; a prop is attached to the rear.

The perch is fitted with locking plates, a prop, and two brackets on the under side for carrying a No. 18 (jointed) draught pole. A strengthening plate extending from the near side stay to the perch eye (overlapping the latter slightly) is riveted to the bottom of the perch. Wire net receptacles are provided at the rear under side of the frame and bronze brackets for the application of a lifting jack.

Both front and rear props, when not in use, are secured by spring clips.

AMMUNITION BOX.

The ammunition box is divided transversely into two main compartments (with lid to each), and is arranged to carry 32 complete rounds of ammunition in baskets, 14 H.E. and 2 Shrapnel in the front and 14 H.E. and 2 Shrapnel in the rear. The front lid has no supporting chains, but in other respects the details of the construction of the box, and the method of its attachment to the frame, are generally similar to that of the limber box.

Two "turnscrews, shell plug" are fitted on the top of the ammunition boxes, one at the front of the near side and the other at the rear of the off side. Two brackets are fitted at the rear for the attachment of the fuze indicator.

BRAKE GEAR.

The tire brake, which acts on the front of the wheels, is actuated from the rear of the wagon by a handle, and consists principally of two brake arms, connecting and actuating rods, a screwed rod, a screw, two crank-shaped levers, and links.

The brake arms are pivoted at their inner end to the perch, and supported by the links to the frame sides; the outer ends are formed with a shoe for cast-iron brake blocks. Each arm is connected to a cranked lever at the rear of the frame on the left side by a screwed rod, and on the right side by a connecting rod; the screwed rod has an actuating handle fitted to its rear end, and

the left hand lever is provided with a nut which engages with the screwed rod; the rear arms of the levers are connected by a rod which carries the motion from one side to the other.

The brake must always be put on when the wagon is supported by the props.

AXLETREE AND WHEELS.

The axletree is of tubular steel, 2nd class "C," No. 106.

The wheels, No 45, are the same as for the carriage.

The wagon is fitted to carry the various stores shown on packing diagram, page 54.

WAGON, TELEPHONE, MARK I.

The wagon consists of body and limber and is constructed to carry electric cable on drums and other stores for field telephone operations, as shown on the diagram of packing, page 56.

BODY.

(Plate XVII.)

The body consists principally of a framework of steel plate with perch and axletree, mounted on two wheels and fitted with brake and winding gear. The framework consists of four futchels (two inner and two outer) held together by front and rear crossbars, the connecting stays being secured to the axletree by flanges. The two inner futchels are prolonged at the front to form a perch to which a perch eye is fitted. Locking plates are riveted to the inner futchels at the front. An operator's seat and footrest are fitted at the rear of the wagon on each side. There are also two pole guard handles fixed at the rear.

The cable drums are of steel plate, and are carried three on the near and two on the off side—the front and rear pair each carrying 1 mile of D. 3 electric cable.

Two "Reels, cable, No. 2" are carried on the perch near the eye, each reel containing $\frac{1}{4}$ mile of D. 1 cable.

Brakes for front drums are fitted, one on each side, to regulate the speed of the drums when travelling. They are of the screw pattern and are actuated from the rear by a handwheel.

Winding gear is fitted to both near and off sides of the wagon and consists of sprocket wheel and pinion and roller chain. The sprocket wheel is actuated by a pawl engaging into a bracket† secured to nave of wheel. The driving strap is adjusted by means of a screw connected to the carrier, and is actuated by a handwheel; by this arrangement of the gearing, the gear can be connected, or disconnected, with either the centre or rear drum. A drum must be in either of these positions to be operated by the gear. Each drum is interchangeable. When winding in the cable, if the speed of the drum is too fast, it can be regulated by slackening the band by means of the actuating handle, so that the band may slip slightly.

† This bracket will be regarded as a component of the wagon and attached to the wheels as required so that the interchangeability of the wheels will not be affected.

To allow of communication whilst on the move, a "Telephone, portable, D, Mark III" will be carried on a bracket fixed to the back rail of the limber seat, the cable being connected from a terminal plate on the left side of the perch to the bearings of each drum on the wagon and to a plug on the top of the limber box, thence to the telephone.

The axletree is 2nd Class "C" No. 194, and the wheels No. 200A†.

The brake gear is of the screw pattern actuated from the rear; the bar is of tubular steel suspended from the frame by steel links, attached to brackets which are riveted to the frame; the brake blocks are of cast iron.

Four telegraph poles are carried on the centre portion of the frame, resting at the rear end on top of, and strapped to, the rear crossbar, and passing under the front crossbar; the ends rest on a leather padded steel plate, to which the poles are also strapped.

A field telegraph ladder is carried under the body of the wagon secured by straps.

LIMBER.

(Plate XVIII.)

The limber consists principally of a framework with an axletree and springs, a box, and draught fittings mounted on two wheels.

The framework consists of four futchels (two inner and two outer) connected by plates; draught hooks are fixed to the front end of the outer futchels and a No. 32 limber hook to the frame at the rear.

The box is made of steel plate and is riveted to the frame. It is divided into compartments for carrying the portable telephones, electric cells and other stores. The top is fitted with a back rest and guard irons, which together form a seat.

The wheels and axletree are the same as for the body.

The draught fittings consist of a Mark III No. 17 pole, a Mark II No. 3 bar, supporting pole, and two No. 11 swingletrees.

For particulars of stores carried both inside and outside, see List of Stores, pages 52 and 53, and also Packing Diagram, page 56. Strapping is provided both on the limber and wagon for securing those stores which are to be carried externally.

WAGON, G.S., MARKS IX TO X*.

The Mark IX wagon consists generally of the following parts:—Body, under carriage, seat, floating raves, brake, axletrees and wheels. It is fitted with a 4-in. scotch roller, whip socket, and two grease boxes.

The body is separate from, but rests on, front and rear under carriages. Allowance is made on the front carriage for slight longitudinal motion, to ensure flexibility to the vehicle for rough travelling. The rear under carriage has two straight guides, which are continued slightly beyond the body.

A locker is formed on the front part of the wagon; the locker is bevelled off to allow the fore carriage to have a greater sweep, and thus minimise the space in which the wagon can turn.

† A certain number of wagons have been issued with No. 198A wheels.

The wagon is fitted for pole draught, which consists of a No. 7A pole, and two No. 13 swingletrees.†

The splinter bar is strengthened by iron stays, which are formed with hooks at the front for the attachment of the swingletrees.

The driver's seat is supported on elliptical springs, to afford easy riding; the springs are fitted to a crossbar, with ends formed to fit over two wood standards, and are kept from being too lively by two leather straps, the seat being fastened to the standards by keys.

The brake, which acts on the rear of the hind wheels, is applied from the driver's seat by a hand lever or from the rear of the wagon by a handle operating a screw. The hand lever is connected by a flexible wire rope on the off side of the wagon to a lever secured to the guides of the rear under carriage and fitting into a loop attached to the rear axletree bed. A brake screw is connected with this lever and a wood crossbar which carries the brake blocks, and which is supported by brackets secured to the end of the guides. When the hand lever is pushed forward the blocks are forced against the wheels. A rack retains the hand lever in position when the brake is applied, and a spring fixed behind the lever serves to ease the blocks off the wheels when the hand lever is released.

The fore axletree is 3rd Class "B," No. 174, and the hind 2nd Class "C," No. 200. The wheels are 3rd Class "B," No. 159, and 2nd Class "C," No. 200, being 3 ft. 9 in. and 4 ft. 8 in. in diameter, respectively, with 24 in. tyre.

The cover is made of waterproof canvas, and can be adjusted to suit varying heights of loads, having on the outside two rows of tabs, with eyelet holes, and on the under side and the hem side lines of white rope. Brass eyelets are secured at intervals along the hem.

The cover is secured to fitments on the wagon by lashings, which should be passed through a row of eyelets on each side and on the back according to the height of the load to be covered.

The side lines of white rope on the under side are for use in reefing the cover when small loads are carried in the wagon; the four on the hem are to keep the cover clear of the wheels.

The sides and rear of the cover not required should be rolled up and stowed away inside, the front portion being stowed behind the driver's seat on full and half loads.

Weight	...	...	...	...	16 cwt. 3 qrs. 25 lb.
Weight of load	...	...	...	...	30 " 0 " 0 "
Minimum space in which the wagon can turn	...	...	...	...	39 ft.
Tonnage { for shipment	...	...	...	...	6754 tons
{ for transport in boats	...	...	...	...	10112 tons
Rectangular space occupied in boats	...	...	...	...	12 ft. 8 in. x 6 ft. 0 1/2 in. x 6 ft. 3 in.

Mark X is generally similar to Mark IX, but of rougher make and is fitted with a sweep bar of angle steel. Weight 15 cwt. 2 qrs. 17 lb.

Mark X* is the Mark X wagon provided with dust excluders, and dust-capped wheels, No. 200A (hind) and No. 159A (fore). Weight, 15 cwt. 3 qrs. 12 lb.

† No. 10A or 11 may be used.

AMMUNITION.

PROJECTILES.					CARTRIDGES.			Means of Firing.
Description.	Marks.	Weight filled and fused.	Bursting charge.		Nature of Fuze.	Nature.	Weight.		Size.
			Nature.	Weight.				
Shell, Q.F., 4.5-inch howitzer— High explosive ...	{ V IV III II I }	lb. oz.	oz.		{ Fuze, grass, No. 100 with Gaine No. 1 or D.A. with cap, Nos. 17 and 44 with adapter. D.A., with cap, Nos. 17 and 44. { Fuze, T and P, No. 82 or 86. { Fuze, T and P, No. 82.	Cordite M.D. Ballistite C.S.P.	15 14 14 2 10	4 1/2 and 2 1/2 A.71 60
		35 0	—	—				
		35 0	—	—				
		35 0	—	—				
		35 0	—	—				
Shrapnel ...	I	35 0	F.G. Powder	3				
Common, practice ... —	{ I }	35 0	R.F.G.†	13 1/4		R.F.G.†	1 8 0 Mark I 1 4 0 Mark II	—
		—	—	—				

† Includes 10 oz. smoke producing mixture.

CARTRIDGE, Q.F., 4.5-INCH HOWITZER, MARK I.

(Plate XIX.)

The cartridge consists of a charge of 15 oz. 14 dra. M.D. cordite, made up in five portions, and contained in a cartridge case fitted in the base with a No. 1 percussion primer.

The first portion of the charge consists of a core of size 2½ cordite with a ring of size 4½; the other portions are rings of size 4½. Each portion is enclosed in a cambric bag and marked on the underside with the weight of the portion, and with the number of the portion, "one" to "five," as the case may be, on the opposite side. The charge is assembled in the cartridge case with the side showing the number of the portions uppermost.

The cartridge is closed with a leatherboard lid which is provided with a lifting band.

Hitherto the cartridge cases were sandblasted and black lacquered outside, but this has now been discontinued.

Each cartridge is contained in a leatherboard lined tin box with a lid having a tear-off band.

CARTRIDGE, Q.F., 4.5-INCH HOWITZER, FILLED 14-OZ. 2-DRS.
BALLISTITE, SIZE, A.71.

The *Mark I* cartridge consists of a *Mark I* empty cartridge with percussion primer No. 1, containing a charge of 14-oz. 2-drs. of ballistite made up in five sections, paper ring with glazed board strips, and glazed board lid.

Each section is enclosed in a cambric bag and their weights are as follows:—

Section one	...	...	...	5 oz. 4½ dra.
Section two	...	...	...	1 " 2½ "
Section three	...	...	...	1 " 7½ "
Section four	...	...	...	2 " 5 "
Section five	...	...	...	3 " 14½ "
				<hr/> 14 oz. 2 dra. <hr/>

The No. 1 section is secured to the base of the cartridge case in two places.

The paper ring is divided by two parallel glazed board strips into three compartments; the No. 1 section is placed in the centre compartment and the outer compartments contain, respectively, the No. 5 section and the Nos. 2, 3 and 4 sections.

The glazed board lid is cup shaped and is fitted with a .875-inch white tape loop.

The *Mark II* cartridge is made up with 5 sections of the same weight as the *Mark I*, but has no paper ring with strips, the Nos. 2, 3, 4 and 5 sections being arranged round the end of the primer projecting into the case, while the No. 1 section is the same diameter as the case and is stitched to the inside of the glazed board lid.

**CARTRIDGE, Q.F., 4.5-INCH HOWITZER, FILLED 1-LB. 0-OZ. 10-DRA.
C.S.P. 60 (MARK I).**

This cartridge is made up similarly to the ballistite cartridge described above except as regards the weights of the various sections, which are as follows:—

Section one	...	...	...	6 oz.	8 dra.
Section two	...	...	...	1 "	3 "
Section three	...	...	...	1 "	8 "
Section four	...	...	...	2 "	11 "
Section five	...	...	...	4 "	12 "
				<hr/>	
				1 lb. 0 oz. 10 dra.	
				<hr/>	

CARTRIDGE, Q.F., 4.5-INCH HOWITZER, BLANK.

The Mark I blank cartridge consists of a charge of 1½-lb. R.F.G.³ powder in a silk cloth bag with shalloon base, enclosed in a service cartridge case, which is closed with a leatherboard lid provided with a lifting band.

The Mark II blank cartridge differs from the Mark I in having a 1½-lb. powder charge, which is contained in a bag provided with a felt jacket.

Instructions for making up these cartridges with charges issued for the purpose, as may be necessary from time to time, will be found on the lid of the box in which the empty cases are received.

CARTRIDGE, DRILL, Q.F. 4.5-INCH HOWITZER.

The drill cartridge consists of an empty case closed with a wood plug and stamped "DRILL." Four holes are drilled in the sides and three in the base of the case to distinguish it from the service cartridge.

PRIMER, PERCUSSION, Q.F. CARTRIDGES, NO. 1.

(Plate XIX.)

The *Mark I** primer consists of a metal body, screwed externally for a portion of its length to fit the hole in the base of the cartridge case. The body is filled with R.F.G.³ powder, the mouth being closed with a metal closing disc with six radial slots. The head is recessed to receive a copper cap (containing 1.2-grains of composition) fitted in a brass chamber. The cap chamber forms the anvil, and has three fire holes. The cap is connected with the gunpowder charge in the body by a channel which contains a soft copper ball in a coned seating to seal the escape of gas after firing and relieve the pressure on the cap. Two small recesses are formed in the flange of the head for the "Key, No. 26."

The *Mark II* primer differs from Mark I* in not having a cap chamber, the cap being placed in a recess in the body and secured by a screwed plug; this plug forms the anvil at one end, the other end being bored out to form the sealing chamber, which is closed by a perforated screwed plug.

Fired Mark II primers which have been refilled will be distinguished by having the letter "R" and the date of refilling stamped on the base, the previous date of filling being barred out.

PRIMER, PERCUSSION, DUMMY, Q.F. CARTRIDGES, No. 1.

The dummy primer is the same shape externally as the service primer, with a hard rubber coned plug in the head held in position by a screwed plug.

SHELL, Q.F., HIGH EXPLOSIVE, 4.5-INCH HOWITZER, MARK I.

The Mark I shell is made of forged steel, and has a steel plate disc screwed in the base. The head is struck with a radius of three diameters, the nose being fitted with a gunmetal bush screwed to the G.S. fuze-hole gauge.

A copper driving band, with two cannellures and the front slope serrated, is fitted into an undercut groove, which has three waved ribs turned in it to prevent the band turning on the shell.

The interior of the shell is varnished.

Mark II shell (*Plate XX*) differ from Mark I in having a longer head and thicker walls.

Mark III shell differ from Mark II in having a larger base plate.

Mark IV shell differ from Mark III only in not having a base plate. Only a small number of these have been made.

Mark V shell are fitted with a 2-inch fuze-hole socket instead of one screwed to the G.S. gauge.

SHELL, Q.F. SHRAPNEL, 4.5-INCH HOWITZER, MARK I.

(*Plate XXI*.)

The body of the shell is of forged steel. A copper driving band, with two cannellures and front slope serrated, is fitted into an undercut groove which has three waved ribs to prevent the band turning on the shell.

The head of the shell is struck with a radius of three diameters, and contains a wood block. It is fitted with a gunmetal fuze-hole socket screwed to the 2-inch fuze-hole gauge, and is secured to the body with screws and twisting pins. The fuze-hole socket is fitted with a fixing screw to secure the fuze.

A tin cup is fitted in the base to contain the bursting charge (3-oz. F.G. powder).

The interior of the shell is lined with brown paper, and contains about 481 bullets (35 per lb.), supported by a steel disc over the tin cup, the interstices being filled in with resin.

A metal tube is screwed into the steel disc, the other end being soldered into the fuze-hole socket.

SHELL, Q.F. COMMON, 4.5-INCH HOWITZER, MARK I.

(For Practice.)

The shell is fitted to take the fuze T. and P. No. 82 or the 2-inch No. 1 fuze-hole plug and is provided with a similar driving band to that described for the shrapnel shell. It is filled with 10 oz. of

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smoke producing composition stemmed in round a central burster of R.F.G.¹ powder contained in a bag, which is enclosed in a paper cylinder.

The shell is issued plugged and is painted black, with two yellow bands $\frac{1}{2}$ inch wide and $\frac{1}{2}$ inch apart painted round the body.

The powder charge should not be left in the shell longer than eight months from date of filling. See Equipment Regulations, Part II, Section XI^c.

FUZZING OF SHELL.

Shrapnel and H.E. — On active service or at practice camp a certain number of Shrapnel shell and High Explosive shell may be fuzed at "Preparation for Action."

DRILL SHELLS.

Empty Shrapnel and empty High Explosive shells are allowed for drill purposes.

FUZE, PERCUSSION, D.A., WITH CAP, NO. 17, MARK III.

(Plate XXII.)

This fuze, which is made of gunmetal, is screwed externally below the head to the U.S. gauge.

The head has a pin on each side to engage the safety cap with which the fuze is furnished.

A safety pin passes through the safety cap and body, the lower end of the hole being closed with a brass screw plug.

The cap and safety pin are removed just prior to loading.

The fuze will be inserted in, or removed from, the shell with the "Key, No. 10," the projection on the side of the latter being inserted in the square slot in the top of the safety cap.

Weight with cap	11 oz.
" without cap	9 oz. 3 drs.

FUZE, PERCUSSION, DIRECT ACTION, WITH CAP, NO. 44.

(Plate XXIII.)

The Mark II fuze, which is made of gunmetal, is screwed externally below the head to fit the U.S. fuze-hole.

The head has a pin on each side to engage in slots in the side of the safety cap with which the fuze is furnished.

The safety cap has two projecting milled edges on the exterior, and two T-shaped slots in the side to engage with the pins projecting from the head of the fuze. Two pins are screwed into the cap at right angles to the slots and engage with the slots in the head of the fuze. Five holes are drilled through the cap, four for the securing pins and a central one, in the bottom of the square recess for fixing key, to take the whipcord, which attaches the safety pin to the cap.

The two securing pins are made of copper and consist of a loop with two legs, the pins being connected with each other by a length of twisted wire having an elongated loop at each end. One leg of each pin is split for the purpose of opening out after being passed through the side of the cap into the T-shaped slot.

A strip of soft brass is soldered to the cap, one end being left free to turn down and secure the wire loop of the securing pins.

The securing pins, cap and safety pin are to be removed immediately prior to loading. Care should be taken in removing the securing pins to withdraw them by a straight pull in the direction of the length of the fuze. When not in shell, the fuzes are packed one in a cylinder, 50 in a "case, wood, packing."

Weight without cap	...	...	8 oz. 0 dra.
" complete	...	...	10 oz. 10 dra.

FUZE, CHAZE, No. 100, MARK I.

(Plate XXIV.)

This fuze is made of metal and is screwed to suit the 2-inch fuze-hole.

The upper part of the body is similar in contour to the No. 80 time and percussion fuze. A holder, which is turned and screwed on the interior to take a No. 1 gauge, is screwed into the base of the fuze.

A slot is provided in the fuze to receive a "Key, No. 16" for fixing purposes.

GAINE, No. 1, MARK I.

(Plate XXIV.)

The gaine, which acts as exploder to the shell, is made of steel and consists of a hollow cylinder containing explosive, screwed externally at one end to suit the screwed recess of the fuze or adapter with which it is used. The screwed end of the cylinder is closed with a shellaced disc, and the opposite end with a screwed plug.

FUZE, TIME AND PERCUSSION, No. 82.

The Mark III fuze (Plate XXV) consists of the following parts, which are made of aluminium, except where otherwise stated:—Body, metal time composition rings (top and bottom), brass time detonator pellet and three retaining bolts with springs, two needle plugs, brass percussion detonator pellet and three retaining bolts with springs, metal base plug, brass spring, brass safety pellet, brass cap, two safety pins, and cloth washers.

The body is screwed externally at the lower end to the 2-inch fuze-hole gauge, and is recessed to receive the percussion detonator pellet with spring, and base plug; a needle plug is screwed into the end of this recess. Three retaining bolts with springs are fitted into the sides of the percussion pellet and body at right angles to the axis of the fuze.

A cloth washer covers the top surface of the flange of body. A brass-lined channel filled with fine grain powder leads from the powder pellet to the base plug.

The stem of the body, which is screwed at the top to take the cap, has four brass-lined holes, at right angles to the axis of the fuze, for the time detonator pellet and three retaining bolts with

springs. A hole is bored, parallel with the axis of the fuze, for the safety pellet.

The circumference of the body is graduated from 0 to 40, a red + indicating the safety point.

The top composition ring has four recesses to correspond with the holes for detonator pellet and retaining bolts in the stem, a needle pellet being screwed into the end of the one for the detonator pellet. A hole is bored from the needle recess to the composition channel and contains a perforated powder pellet. A gas escape hole is provided at the commencement of the composition, and is closed with a brass disc. The ring is pinned to the stem to prevent it turning.

The bottom composition ring is movable, and is provided with a slot to take the "Key, No. 19."

A hole through the ring at the commencement of the composition contains a perforated powder pellet to communicate with the top ring. The upper surface of the ring is covered with a cloth washer.

A gas escape hole is provided at the commencement of the composition, and is closed with a brass disc.

The time detonator pellet contains a detonator consisting of .75 grain of detonating composition, and a .37 grain powder pellet.

The pellet is engaged by the right and left retaining bolts, which are held together by the third retaining bolt, the latter being fixed by the safety pellet and safety pin.

The percussion detonator pellet is bored to receive a 3-grain detonator and a perforated powder pellet. It has three recesses corresponding with the holes for the retaining bolts in the body, and is keyed to the body to prevent it turning. A brass cap with a central hole and a shallow disc covers the recess containing the pellet.

The spiral spring is to prevent creep action.

The base plug contains fine grain powder, a hole in the centre being closed with a muslin disc.

The safety pellet retains the time pellet retaining bolt until the shock of discharge, and is suspended in the body by a copper shearing wire and safety pin.

The cap is screwed to the stem of body, it has two slots for the reception of a key, and is fixed with a steel set screw.

The fuze is stamped T on the top composition ring close to the time safety pin, and P on the body close to the percussion safety pin. The pins are each provided with a whipcord becket or loop, the T one being scarlet and the P one tarred.

The time of burning is about 40 seconds.

Weight, 1 lb. 2 oz. 10 gra.

To set the time arrangement, the bottom ring is moved round with the "Key, No. 19" until the graduation ordered, and the setting mark, coincide.

If the fuze is required to act as a percussion fuze only, the P-pin only should be removed, otherwise both pins should be removed. This, however, should not be done until the moment of loading.

The Mark II fuze differs from the Mark III in having no brass lining to the flash holes in body and in the base plug and cap, being of aluminium instead of brass.

The Mark I fuze differs from the Mark II in the holes for the detonator and powder pellet in the percussion pellet being bored eccentrically instead of centrally, the needle plug being also arranged to suit in the body of the fuze.

Action of Fuze—Time Arrangement.—On shock of discharge, the safety pellet sets back shearing the suspending wire, and releases one of the retaining bolts. The centrifugal motion of the shell now causes the retaining bolts and the time detonator pellet to fly outward, and the latter coming into contact with the needle plug fires the detonator.

The flash passes to the composition in the underside of the top ring and burns until it reaches the hole in the bottom ring, the composition of which burns back in the opposite direction until it reaches the hole in the body where it flashes down to the base plug and into the shell.

Percussion Arrangement.—The centrifugal motion of the shell causes the retaining bolts of the percussion pellet to fly outward, leaving the percussion pellet free to move forward on impact or graze, on to the needle plug, firing the detonator, the flash then passing to the base plug and into the shell.

FUZE, TIME AND PERCUSSION, No. 86.

(Plate XXVI.)

This fuze consists of the following principal parts, which are made of Aluminium alloy, except where otherwise stated:—

Body, top and bottom composition rings, cap, metal time detonator, pellet with steel four-winged spring, steel needle plug, metal percussion detonator pellet, metal hinge cage, safety ring, brass distance ring, inner and outer base plug, brass time (1) and percussion (2) safety pins, brass closing pellets with springs, cloth and vegetable paper washers, etc.

The body has the lower part screwed externally to the 2-inch fuze-hole gauge, while the upper part is turned and screwed to receive the composition rings and cap. The bottom of the fuze is bored out and screwed to receive the percussion arrangement and base plugs, and the top is bored out to receive the time arrangement. A hole is bored through the flange separating the time and percussion arrangement, and is screwed to receive the needle pellet, which has a needle at each end, a lead washer being pressed into a recess on the underside of the flange to make a gas-tight joint. A communication hole is bored through the side of the stem into the time hammer chamber, and another hole (which is filled with powder pellets) leads from the top face of the body to a magazine between the inner and outer base plug. The exterior face of the body is graduated from 0 to 40 and a projecting pin provided for fixing purposes.

The bottom ring is removable and is provided with a setting mark, and with a projecting pin for setting purposes. A circular composition channel is provided in the lower face and with a hole leading

from the channel to the top of the face to communicate with the top ring.

The *top composition ring* is keyed to the stem of the body by two pins. It has a composition channel similarly to the bottom ring and has a hole to communicate with the chamber containing the time detonator pellet.

The *time detonator pellet* contains a detonator and is suspended in the chamber in the top of the stem by a four-winged spring and by a safety pin.

The *percussion detonator pellet*, which has a small lead ring let into the bottom of it, rests upon a cone formed on the inner base plug and is enclosed by a steel bulge cage, which is a series of springs with a bulge at the top rising from a solid base. This solid base is securely held between the distance ring and the base plug. The heads of the springs are encircled by the safety ring which rests upon the "bulges" of the springs and is held up by two safety pins.

The fuze has three safety pins, one for the time detonator pellet which passes through the cap, and two for the percussion detonator pellet which passes through the flange of the body. The pin holes are closed by spring pellets when the pins are removed.

If the fuze is required to act as a percussion fuze only, the P pin only will be removed. For use as a time fuze the P pins as well as the T pin will be removed.

ACTION.

Time arrangement.—On shock of discharge the weight of the time detonator pellet overcomes the four-winged spring, sets back and fires the detonator, the flash of which ignites the composition in the top ring; this burns round to the hole communicating with the bottom ring, the composition of which burns back in the opposite direction to the communicating hole in the body, whence the flash is conveyed to the magazines between the two base plugs and into the shell.

Percussion arrangement.—On shock of discharge the safety ring sets back over the bulges of the bulge cage into the bottom of the recess, and the percussion pellet also sets back and grips on its coned seating by means of the lead ring. On impact or graze the arms of the bulge cage open out and the percussion pellet goes forward and fires the detonator. This lights the powder pellet in the centre of the inner base plug and flashes through the four communicating holes to the magazine in the outer base plug.

FUZES, DRILL.

The No. 82 drill fuze is made of metal bored out in the interior and turned on the exterior to the same contour as the service fuze. It is blackened all over, with the exception of the graduated flange on the body and a space round the setting mark on the lower composition ring, which are left bright. It is stamped "DRILL" on the cap, and is provided with steel safety pins.

Some drill fuzes have been issued which have been converted from burnt-out service fuzes. No more of these will, however, be made.

The No. 17 drill fuze consists of a burnt-out service fuze blackened on the exterior and fitted with steel safety pin. It is stamped "DRILL."

MISCELLANEOUS STORES.

RULE, RANGE, Q.F., 4.5-INCH HOWITZER.

(Plate XXVII.)

The range rule is made of boxwood on the ordinary slide rule principle, and is used in conjunction with the elevation scale drum and hand wheel of the No. 1 Carrier for No. 7 dial sight or bar sight to enable ranging to be carried out in yards with all charges.

The rule also shows the limit of each charge.

With the 4th charge the real range is used, with any other charge the scale on the slide portion of the range rule shows the gun range, i.e., the number of yards (false range) to which the howitzer would have to be elevated to get the required elevation.

The two scales on the range rule are logarithmic. The top scale markings are from 500 to 7,000 yards real range.

The sliding scale markings are from 400 to 5,400 yards, and are exactly the same logarithmic proportions as the top scale. On this slide a red line 20 degrees is marked opposite 3,445 yards to enable the battery commander to ascertain what charge to use to obtain an angle of descent of 20 degrees. At all elevations beyond this graduation all angles of descent are more than 20 degrees. The bottom portion is marked 1, 2, 3, 4, 5, to enable the red arrow on the centre scale to be moved to whatever charge is desired.

Assume No. 5 charge is being used. The red arrow is moved opposite 5 on the lower scale. Any particular real range on the top scale reads against a false range on the centre scale. This false range is given to the howitzer.

Similar action to be adopted when any of the other charges are being used.

INDICATOR, FUZE, Q.F., 4.5-INCH HOWITZER.

(Plate XXVIII.)

The indicator consists of the following principal parts: base plate, slide, slide clamp, reader, stops and stop screws.

The base plate is of Delta metal about 33 inches long, graduated on the upper portion with a yard scale and on the lower with a scale for 5 charges; it is grooved in the centre to receive the slide, which is graduated with a fuze scale and a corrector scale.

The charge scale is covered by a plate which only exposes the arrow of the charge required.

The corrector scale is divided into divisions reading from 100 up to 200, 150 being the normal.

The slide can be clamped in any position desired by means of the clamp, which is attached to the base plate, its travel being limited by stops. The yard and fuze scales are read by the reader, which is free to move along the base plate, but is prevented from coming off the base plate by stop screws; attached to the reader is a small spring, which can be manipulated by a screw for taking up any play in the reader due to wear.

DRIFT, No. 3.

The No. 3 drift is of brass and is for use in removing the parts of the breech mechanism.

SCREWDRIVER, ARMOURERS', SMALL.

The screwdriver is for use in removing and replacing small screws.

GAUGE, STRIKER PROTRUSION, No. 1.

The gauge is of steel plate and is for use in gauging the protrusion of firing pins of strikers of Q.F. 4.5-inch howitzer and Q.F. and Q.F.C. guns 3-inch and upwards.

Instructions for use of Gauge.

See "Regulations for Magazines and Care of War Matériel."

WRENCH, BREECH MECHANISM, No. 90.

The No. 90 breech mechanism wrench is of steel and is for use in removing and replacing the "cover plate retaining catch bush," "cylinder nut retaining catch nut," "firing pin retaining nut," "firing hole bush," and all large screws.

CLEANER, PIASABA, No. 8A.

The cleaner consists principally of two cylindrical brushes separated by a distance piece and mounted on a brass tubular bolt which holds the whole together, and through which is passed a rope lanyard knotted at each end of the bolt; the lanyard is provided with a loop at one end and a lead ball at the other.

CASE, No. 8 OR 8A CLEANERS.

The case is of waterproof canvas formed to hold the cleaner with lanyard, white line and lead ball, and is provided with a leather strap 1 inch by 36 inches long, with buckle. The strap is attached to one side of the case by means of two copper rivets, and serves for securing the case to the carriage.

BRUSH, PIASADA, Q.F. 4.5-INCH HOWITZER, BORE.

The brush is for use in cleaning the bore of the howitzer. It consists of a head and stave; the head is built up of several components which may be replaced as required; the stave is of ash 8 feet $4\frac{1}{2}$ inches long, $4\frac{1}{2}$ inches being fitted into the head.

FUNNEL, Q.F. 4.5-INCH HOWITZER.

The funnel is for use in filling the hydraulic buffer. It consists of a conical-shaped leather receiver, which is secured in a gun-metal socket by a nut; the socket is fitted with a strainer and a bent tin spout to suit the filling hole of the buffer; the spout is fluted to assist the escape of the air.

TOOLS, WITHDRAWING RING SUPPORTING PACKING,
Q.F. 4.5-INCH HOWITZER.

The tools are made of steel wire, and are for use in withdrawing the "rings, supporting packing" from the hydraulic buffer; one end is screwed to suit the lapped holes in the rings.

RAMMER, Q.F. 4.5-INCH HOWITZER.

The rammer is a plain ash stave with a copper protesting ring at one end.

COVERS { SIGHT BRACKET AND HIND SIGHT, Q.F. 4.5-INCH HOWITZER.
BREECH, Q.F. 4.5-INCH HOWITZER.
MUZZLE, No. 17.

The covers are made of waterproof canvas and are fitted with suitable straps. Their use is indicated by their name, and when not in use they are strapped to the shield.

SPANNER, No. 93.

The spanner is of steel and is for use with the dust cap and pipe box nut of No. 45 wheels.

SPANNER, HYDRAULIC BUFFER, No. 147.

The spanner is of steel and is for use with the cylinder nut and spring compressor of the carriage.

IMPLEMENTS, AMMUNITION.

KEY, No. 26 (MARK II)—PRIMER, 4.5 INCH AND 4 INCH.

KEY, No. 26 (MARK I)—PRIMER, 4.5 INCH.

The Mark II key is made of steel, cranked to fit over the base of the cartridge case and having two oil toughened pins to engage with the two recesses in the head of the primer. It is fitted with a white cotton lanyard.

The Mark I key is shorter in the crank portion than the Mark II key.

IMPLEMENTS, AMMUNITION—continued.

KEY, No. 36 (MARK I).

This key consists of a steel bar with a semi-circular end shaped to suit the bottom time ring of the No. 82 fuze, also to show the setting mark, and provided with a projection in the semi-circular portion to suit the slot in the fuze for setting purposes.

KEY, No. 19 (MARK I)—Nos. 17 AND 82 FUZES.

KEY, No. 19 (MARK II)—No. 82 FUZE.

The Mark I key is of steel, the ends being shaped and provided with projections to suit the flange on the body of the No. 82 time and percussion fuze, one end being used for inserting and the other for removing the fuze from the shell. The ends are marked accordingly.

A screwdriver is formed at one end for the fixing screw of the shell and a projection at the other end to fit the setting hole in the lower time ring of the fuze. It has also a projection on the centre of the body of the key to fit the square hole in the cap of the No. 17 fuze for fixing purposes.

The key is fitted with a white cotton lanyard.

The Mark II key differs from the Mark I in not having the screwdriver nor the projection for fixing the No. 17 fuze. This key will be issued when existing stock of Mark I is used up.

KEY, No. 16.

The *Mark II* key is made of steel with a projection at one end to engage in the slot in the body of the No. 100 fuze for fixing purposes. It is fitted with a loop of white cotton line.

The *Mark I* differs from the Mark II in having two horns, one on each side of the projection.

KEY, No. 10 (MARK I)—Nos. 17 AND 41 FUZES.

The key is of steel with a screwdriver at one end and a projection on one side to fit the square hole in the cap of the No. 17 fuze for fixing purposes. The projection has a semi-circular notch cut in it to clear the knot of the safety pin of Nos. 44 and 45 D.A. percussion fuzes. It is fitted with a loop of white cotton line.

This key will be issued when existing stock of "Key, No. 19, Mark I," is used up.

ADAPTER, 2-INCH FUZE-HOLE, No. 2 (MARK I).

This adapter is for use to adapt High Explosive shell with 2-inch fuze-hole to G.S. gauge. It has a tapered flange on the exterior, below which it is screwed to suit the 2-inch fuze-hole, leaving a plain portion (1.85 inches diameter) at the bottom. It is bored through the centre and screwed to the G.S. fuze-hole gauge.

CARE AND PRESERVATION.

(See also "Regulations for Magazines and Care of War Matériel.")

Any adjustment required must be carried out by an Armament Artificer.

HOWITZER AND ITS FITTINGS.

The breech should be kept covered, when possible, to prevent dust and grit getting into the interstices of the breech fittings, which might impede their easy working; a waterproof canvas cover is provided for the purpose.

If the howitzer is removed from the carriage, it should be placed on supports so arranged as to be under the jacket and "A" tube. On no account should the bronze liners be allowed to rest on the supports.

CARRIAGE, &c.

To facilitate using and removing the lifting jack, when used on a carriage, place pieces of wood (about 2 inches thick) under the wheels, or, if in camp, make a small excavation under the foot of the jack.

Before applying the lifting jack to the rear of the wagon body, the perch prop should be lowered to prevent extra weight being thrown on to the limber hook.

LIST OF LUBRICATING HOLES.

Fittings which are provided with oil holes for lubricating purposes.	No. of Holes.	Position of Holes.
Carrier, No. 7 dial sight, No. 1 ...	4	One in left upper side of deflection bracket, one in upper side of left and right trunnion bearings respectively, and one in right upper side of reciprocating bracket.
Gun— Lubricators in guides on either side of "A" tube	4	Two on either side.
Saddle— Bearing, pinion shaft	1	Inside saddle, near right arc pinion for lubricating shaft (only visible when the howitzer is at full depression).
Body	2	Inside; 1 on left, and 1 on right side for lubricating bearing surfaces.
Bracket, worm spindle	1	Near handwheel, elevating.
" " wheel	4	1 inside saddle, near left arc pinion for lubricating shaft (only visible when the howitzer is at full depression), and 3 outside (1 for lubricating worm and 2 for worm spindle).
Cap-squares (2)† each	1	On top.
Pivot	2	Under centre of arc pinion shaft.
Cradle— Head of compressor, running out springs	1	Accessible by removing front cap.
Gear, brake— Handle, actuating, front	1	
" " rear	1	
Pins, axis lever (2) each	1	On each side of trail.
" connecting arm (2)	1	" " "
Link, eccentric	1	
Gear, clamping cradle— Bearings, clamp (2) each	1	Inside trail, 1 on each side.
Gear, traversing— Bearing, pivot	1	Near handwheel, traversing.
Nut, actuating screw	1	Under cover (or sleeve).
Clip, securing traversing lever ...	2	On lid of trail box, in plunger bearings.
Lever, traversing	1	At jointed end of lever, near plunger.
Shield	9	In hinges of upper portion.
Wheels, 2nd class "C" No. 15 (2), each	1	In inner flange.

Note.—In order to assist in identifying the position of the lubricating holes the heads of the screws should be kept free from paint.

† To lubricate trunnion bearings, disengage the plungers from the elevating arcs and elevate the arcs as far as possible. Pour oil into the hole in the cap-squares, keeping the cradle swinging in the trunnion bearings while the oil flows. The trunnion bearings should be lubricated frequently.

DIMENSIONS, WEIGHTS, &c.

DIMENSIONS.

Carriage and Limber—		ft.	in.
Height	to axis of howitzer (spade buried)	3	9
	to axis of eyepiece (dial sight)	4	8
	to axis of upper prism holder (dial sight)	5	3
	to line of sight (bar sight)	3	11
	maximum (dial sight and carrier removed)—		
	carriage with upper portion of shield "up" ...	5	0
	carriage with upper portion of shield "down" ...	4	10
	limber	4	11½
	limber with guard irons removed	4	1
Width, maximum		6	3½
Length	carriage with howitzer, traversing lever folded ...	12	3
	carriage with howitzer, traversing lever in working position	13	6
	limber, carriage { with pole	14	5
	without pole	6	7
	between axletrees	10	0½
	with pole (point of pole on ground)	25	7½
	without pole	16	8
Greatest projection beyond track of wheels		0	6½
Wheels {	track	5	3
	height	4	8
Space required to turn in { minimum width of road		27	0
diameter of turning circle		33	0
Angle of	lock	deg.	min.
	trail (spade buried)	52	30
	upsetting	16	0
	elevation, maximum	36	0
	depression, maximum	45	0
		5	0
Ammunition Wagon and Limber—		ft.	in.
Height	maximum—		
	limber	4	11½
	limber with guard irons removed	4	1
	wagon	4	9½
Width, maximum	wagon with guard irons removed	3	11½
	limber, wagon { with pole	6	3½
Length	without pole	14	5
	between axletrees	5	7
	wagon	9	10
	with pole (point of pole on ground)	8	7½
	without pole	23	0
Greatest projection beyond track of wheels		14	3
Wheels {	track	0	6½
	height	5	3
Space required { minimum width of road		4	8
to turn in { diameter of turning circle		23	6
		30	0
Angle of {	lock	deg.	min.
	upsetting	62	30
		35	0

LIST OF STORES.—CARRIAGE.

Articles.	No.	Where carried.
Brush, paint, ash tool, No. 6	1	In tool case, underspanner No. 285.
Brush, breech screw	1	In pocket, left brake arm.
Can, lubricating, No. 9	1	In wood block inside trail, right side.
Carrier, No. 7 dial sight, No. 1	1	In trail box.
Case, dial sight carrier, Q.F. 4.5-inch howitzer	1a	In trail box.
Case, No. 7 dial sight, No. 1	1	Rear of shield, right side.
Case, Mark III or IV field clinometer, No. 1	1a	On rear of shield, right side.
Case, Nos. 8 or 8A cleaners	1	On right brake arm.
Case, spare parts, Q.F. 4.5-inch howitzer	1a	On rear of shield, right side.
Case, tools, Q.F. 4.5-inch howitzer	1a	On front of shield.
Cleaner, pins, No. 8A	1	In case, right brake arm.
Clinometer, field, Mark III or IV	1	In case, rear of shield, right side.
Cover, breech, Q.F. 4.5-inch howitzer	1	On front of shield } When not
Cover, muzzle, No. 17	1	On front of shield } on gun.
Cover, sight bracket and hind sight, Q.F. 4.5-inch howitzer	1	On front of shield when not on sight and bracket.
Drift, No. 3	1	In tool case.
Funnel, Q.F. 4.5-inch howitzer	1	In tool case.
Gauge, striker protrusion, No. 1	1	In case, spare parts.
Hammer, claw, 24-oz.	1	In tool case.
Implements, ammunition—		
Key, No. 19, Mark I—Nos. 17 and 82 fuzes	1c	In pocket, left brake arm.
Lenther, chamois	1	As convenient.
Oil, Rangoon pint	$\frac{1}{2}$	In No. 9 lubricating can.
Ordnance, Q.F. 4.5-inch howitzer—		
Bush, firing hole spare	1d	In case, spare parts.
Pins, firing "	2	In case, spare parts.
Spring, catch, breech mechanism lever "	1	In case, spare parts.
Spring, main "	1b	In case, spare parts.
Striker "	1	In case, spare parts.
Pliers, flat nose pair	1	In case, spare parts.
Pocket, breech brush, No. 1	1a	On left brake arm.
Pocket, key, fuze, field carriage	1a	On left brake arm.
Posts, aiming	2	Inside of trail, left side.
Rammer, Q.F. 4.5-inch howitzer	1	Inside of trail, left side.
Ropes, dng, light, G.S. (34 in. rope) pair	1	On front of shield.
Screwdriver, armoured, small	1	In case, spare parts.
Shovel, G.S.	1	Right side of trail.
Sight, bar, carriage, field, Q.F. 4.5-inch howitzer	1	In position on carriage.
Sight, dial, No. 7	1	In case, rear of shield, right side.
Spanner, adjustable, 15-inch	1b	In tool case.
Spanner, hydraulic buffer, No. 145	1a	In tool case.
Spanner, hydraulic buffer, No. 146	1a	In tool case.
Spanner, McMahon, 9-inch (or adjustable 11-inch)	1	In tool case.
Spanner, No. 284	1a	In tool case.
Spanner, No. 285	1a	In tool case.
Tool, withdrawing split pins	1a	In tool case.
Wrench, Breech mechanism, No. 90	1	In tool case.

a Component of carriage.

b Per Section.

c When existing stock is used up, 1 "Key, No. 19, Mark II—No 82 fuze," and 1 "Key, No. 19—No. 17 fuze" will be issued in lieu.

d Per Battery.

LIMBERS.

(Carriage and Ammunition Wagon.)

Article.	No.		Where carried.
	Carriage.	Wagon.	
Axes, { heads, 4½ lb.	2	2	Under limber.
pick { helvcs, 30 inch, ferruled	2	2	Under limber.
Bar, supporting draught pole,			
No. 3 spare	1	1 c	On platform board.
Blankets, U.S.	3	3	On top of limber box.
Box, grease, 3 lb.	1 a	1 a	Under platform board,
			"off" side.
Breastpieces spare	1	1	On platform board.
Brush, water, carriage	1	1	Under platform board,
			"near" side (in case).
Buckets, water, U.S., canvas ...	12	6	In wire net receptacles.
Cans, lubricating { for mineral oil	1 a	1 a	} Under platform board,
ting, No. 3 { for Hangoon oil	1 a	1 a	
Cap, dust, 2nd class "C" capped			
wheels, No. 1	1 b	—	In tray small stores, No. 2.
Carrier, ammunition, Q. F. 4.5-inch			
howitzer	1	1	Under blankets.
Carrier, retarding valve, carriage,			
Q. F. 4.5-inch howitzer ... spare	1 d	—	In tray small stores.
Cartridges	12	16	In ammunition box.
Case, can, lubricating, No. 3 ...	2 a	2 a	Under platform board,
			"near" side.
Catch, limber hook, No. 2, spare	1 b	—	In tray small stores, No. 1.
Chalk, prepared, white	f	—	In tray small stores, No. 1.
Cloths, sponge	10	—	In tray small stores, No. 2.
Collars, adjusting 2nd class "C"			
capped wheels spare	1 d	—	In tray small stores, No. 2.
Collar, dividing piston and valve,			
carriage, Q. F. 4.5-inch howitzer			
spare	1 d	—	In tray small stores, No. 1.
Covers, short rifle	2	2	Front of ammunition box.
Crowbar, 4 ft. 1 in.	1 b	—	On footboard.
Dice, testing dial sight carrier ...	1 d	—	In tray small stores, No. 2.
			In tray small stores, No. 1.
Files { smooth, flat, 6-inch	1	—	In tray small stores, No. 1.
second cut, half-round,			
Files { 6-inch	1	—	In tray small stores, No. 1.
smooth, hand, safe edge,			
8-inch	1	—	In tray small stores, No. 1.
Fuzes, percussion, D. A., with cap,			
No. 17 or 44	10	12	In ammunition box.
Fuzes, time and percussion, No. 82	2	4	In ammunition box.
Grease, lubricating, for cool			
climates lb.	3	3	In grease box.
Handle, catch, No. 23, black H,			
limber hook spare	1 b	—	In tray small stores, No. 1.

a Component of limber.

b Per Section.

c Per Sub-section.

d Per Battery.

f As required.

LIMBERS.

(Carriage and Ammunition Wagon)—continued.

Article.	No.		Where carried.
	Carriage.	Wagon.	
Handle, file, small... ..	1	—	In tray small stores, No. 1.
Hooks, bill	1	1.	Under platform board, "off" side (in case).
Implements, ammunition—			
Keys, No. 10, Mark I—Nos. 17 and 82 fuses	2g	2g	In pockets, rear of ammu- nition box.
Key, No. 26 (primer)	1	—	In tray small stores, No. 1.
Key, split, flat, 1-in. x 4-in. spare	1	—	In tray small stores, No. 1.
Oil, mineral (for buffers) pinta	2	2	In lubricating can.
Oil, Rangoon	1½	1½	In lubricating can.
Ordnances, Q. F. 4.5-inch howitzer—			
Extractor spare	1b	—	In tray small stores, No. 1.
Pin, actuating firing lever ...	1b	—	In tray small stores, No. 1.
Pin, keep, trigger	1	—	In tray small stores, No. 1.
Plate, cam, breech			
mechanism lever	1b	—	In tray small stores, No. 1.
Spring, catch retaining cover plate	1b	—	In tray small stores, No. 1.
Spring, catch retaining cylinder nut	1b	—	In tray small stores, No. 1.
Spring, safety stop	1d	—	In tray small stores, No. 1.
Trigger, Mark I (e)	1b	—	In tray small stores, No. 1.
Pin, draught, No. 3	1	—	In tray small stores, No. 1.
1-in x 6-in.	1b	—	In tray small stores, No. 1.
1-in. x { 3½-in.	1b	—	In rectangular tin box, tray small stores, No. 1.
{ 2½-in.	1b	—	
{ 1½-in.	1b	—	
Pins, keep, split { 2-in.	1b	—	
{ 1½-in.	1b	—	
{ 1-in.	1b	—	
1½-in. x 1-in.	1b	—	
1½-in. x 1-in.	1b	—	
1½-in. x ½-in.	1b	—	
Pins, lynch, 2nd class "C" cap- ped wheels spare	1d	—	In tray small stores, No. 2.
Piston, carriage, Q. F., 4.5-inch howitzer	1d	—	In tray small stores, No. 1.
Plugs, filling hole, hydraulic buffer, No. 13 spare	1	—	In tray small stores, No. 1.
Pockets, key, fuse, wagons ammunition and limbers ...	2a	2a	Rear of ammunition box.
Primers, percussion, Q. F. (Art- ridges, No. 1 (in tin box) spare	4	—	In tray small stores, No. 1.
Rings, packing, hydraulic buffer, Q. F. 4.5-inch howitzer:—			
Asbestos spare	2	—	In tray small stores, No. 1.
Leather spare	2	—	In tray small stores, No. 1.
Ring, securing leather packing, carriage, Q. F. 4.5-inch howitzer spare	1d	—	In tray small stores, No. 1.
Screwdrivers, G. S., 6-inch ...	1	—	In tray small stores, No. 1.

a Components of limber.

c Per Sub-section.

b Per Section.

d Per Battery.

g When existing stock is used up 2 "Keys, No. 10, Mark II—No. 82 fuses," and 2 "Keys, No. 10—No. 17 fuse" will be issued in lieu.

e Mark II trigger is carried in tray small stores, No. 2.

LIMBERS.

(Carriage and Ammunition Wagon)—*continued.*

Article.	No.		Where carried.
	Carriage.	Wagon.	
Screw, lubricating hole, bosshead 3/8-inch by 4-inch ... spare	2	—	In tray small stores, No. 1.
Screws, lubricating hole, boss- head 3/8-in. x 1/2-in. ... spare	1 b	—	In tray small stores, No. 1.
Shells, Q.F., H.E. 4.5-inch howitzer	10	12	In ammunition box.
Shells, Q.F., shrapnel, 4.5-inch howitzer	2	4	In ammunition box.
Shovels, U.S.	1	2	On footboard.
Spades, Mark III	1	2	On sides of ammunition box.
Spring, pawl, gear, clamping cradle spare	1	—	In tray small stores, No. 1.
Spring, bracket, supporting sight, carriage, Q.F. 4.5-inch howitzer square	1	—	In tray small stores, No. 1.
Spring, catch, limber and perch hooks spare	1	—	In tray small stores, No. 1.
Spring, clip, securing traversing lever, Q.F. 4.5-inch howitzer square	1	—	In tray small stores, No. 1.
Spring, pin, casquare, Q.F. 4.5- inch howitzer spare	1	—	In tray small stores, No. 1.
Spring, plunger, gear, locking cradle, Q.F. 4.5-inch howitzer square	1	—	In tray small stores, No. 1.
Springs, fixing, nut pipe-box, 2nd class "C" wheels	1 b	—	In rectangular tin box, tray small stores, No. 1.
Springs, shield shutter, Q.F. 4.5-inch howitzer ... square	1	—	In tray small stores, No. 1.
Spring, spiral, automatic clamp, bar sight, Q.F. 4.5-inch howit- zer spare	1	—	In tray small stores, No. 1.
Spring, traversing lever, Q.F. 4.5-inch howitzer ... square	1	—	In tray small stores, No. 1.
Straps, supporting { front ... square	2	2	On platform board.
	1	1	On platform board.
Straps, trace spare	2	2	On platform board.
Swingletrees, No. 11 ... spare	1	1	On platform board.
Tools, withdrawing rings support- ing packing, field carriages ...	2	—	In tray small stores, No. 1.
Traces, masonry ... spare pairs	1	1	On platform board.
Tugs, trace spare	2	2	On platform board.
Valve, recoil, carriage, Q.F. 4.5- inch howitzer spare	1 d	—	In tray small stores, No. 1.
Valve, retarding, carriage, Q.F. 4.5-inch howitzer ... square	1 d	—	In tray small stores, No. 1.
Washers, drag, 2nd class "C" cupped wheels spare	1 d	—	In tray small stores, No. 2.
Washers, packing, hydraulic buffer, Q.F. 4.5-inch howitzer, sets spare	2	—	In tray small stores, No. 1.
Wrench, adjusting No. 7 dial sight and carriers	1 b	—	In tray small stores, No. 1.

b Per Section.

c Per Sub-Section.

d Per Battery.

AMMUNITION WAGON.

Article.	No.	Where carried.
Axe, felling, curved helve	1c	On ammunition box, "off" side (in case).
Blankets, G.S.	3	On top of ammunition box.
Box, grease, 3-lb.	1a	Under wagon, "off" side.
Box, lamp, siege, to hold 2	g	On top of ammunition box.
Brush, pinamba, Q. F. 4.5-inch howitzer, bore	1d	Under perch.
Cartridges	32	In ammunition box.
Case, saw, hand	2	On ammunition box, "near" side.
Fuze, percussion, D.A., with cap, No. 17 or 44	28	In ammunition box.
Fuze, time and percussion, No. 82	4	In ammunition box.
Grease, lubricating, for cool climates lb.	3	In grease box.
Handspikes, common, 6-ft.	1	Under perch.
Implements, ammunition— Keys, No. 10, Mark I—Nos. 17 and 82 fuzes	2i	In pockets on ammunition box.
Indicator, fuze, Q. F. 4.5 inch howitzer	1	On back of wagon (for use and travelling).
Kettles, camp, oval, 12-quarts ... ..	...	(Under wagon, as required.
Lamps, siege	2a	In box, top of ammunition box.
Lashings, tarred, { 10-feet { 20-feet	g 1f	Under wagon. Under wagon (lashingspare pole).
Line, Hambro'	1c	In net-work receptacle.
Line, white, 1 lb. skein	1c	In net-work receptacle.
Pockets, key, fuze, wagons ammunition and limbers	2a	On ammunition box.
Pole, draught, No. 18, Mark II (jointed) spare	1	Under perch.
Ropes, drag, light, G.S. (2½ inch) pairs	1	On top of ammunition box.
Ropes, picketing, 66-feet... ..	h	On top of ammunition box.
Saws, hand, 26-inch	2	In case, ammunition box, "near" side.
Shell, Q. F., H.E., 4.5-inch howitzer	28	In ammunition box.
Shell, Q. F., shrapnel, 4.5-inch howitzer	4	In ammunition box.
Spanner, No. 93	1c	On side of ammunition box, "off" side.
Valise, fitters' or wheelers' tools	1b	On top of ammunition box.
Valise, horse shoes	1	On top of ammunition box.
Valise, saddlers' tools	1b	On top of ammunition box.
Valise, shoeing tools	1b	On top of ammunition box.

Component of wagon.

b Per Section.

c Per Sub-section.

d Per Battery.

f Each wagon carrying a spare pole.

g As required.

h One rope per 15 horses.

i When existing stock is used up, 2 "Keys, No. 10, Mark II—No. 82 fuze," and 2 "Keys, No. 10—No. 17 fuze," will be issued in lieu.

WAGON, TELEPHONE.

Articles.	No.	Where carried.
Apron, basil, browa	1	Limber box, compartment C 1.
Axe, felling, curved helve	1	Under footplate of limber.
Axe, pick { head, 4½ lb.	1	} Near side, limber.
{ helve, 38-inch, feruled... ..	1	
Bar, carrying drum, wagon, telephone	1	Top of limber box.
Bar, supporting draught pole, No. 3 (spare)	1	Platform board, limber.
Blocks, brake, field and transport (spare)	2	Limber box, compartment C 2.
Bolts, link, chain, endless, wagon, telephone (spare)	2*	Limber box, compartment D.
Box, spare coils, large	1	Limber box, compartment A.
Bracket, pawl, winding gear, No. whuclt (spare)	1	Limber box, compartment D.
Brush, water, carriage... ..	1	Near side limber.
Buckets, water, U.S., canvas	2	Platform board, limber.
Cable, electric, D 1 miles	3	On reels, cable, No. 2.
Cable, electric, D 3 "	4	On drums.
Can, oil, lubricating, 1 pint	1	Limber box, compartment E.
Catch, drum spindle bearing, wagon, cable and telephone .. (spare)	1*	Limber box, compartment D.
Cells, electric, f	16	Limber box, compartment A.
{ (spare) in box	16	Limber box, compartment A.
Clip, strap, winding gear, wagon, telephone (spare)	1*	Limber box, compartment D.
Cloth, emery, No. F sheets	4	Limber box, compartment U 2.
Collar, adjusting, 2nd Class "C" capped wheels (spare)	1	Limber box, compartment B 3.
Cordage, spun yarn, { 1 thread lb.	20	Limber box, compartment D.
{ 3 thread "	5	Limber box, compartment D.
Covers, short rifle	2	Front of limber box.
Drums, cable, wagon telephone	5	Wagon body.
Galvanometer, detector—		
Q and 1	1	} Limber box, compartment A.
Case... ..	1	
Grease, lubricating lbs.	3	Grease box, under limber.
Guards, hand, telegraph equipment	2	Limber box, compartment D.
Guys, telegraph pole	4	Limber box, compartment B 4.
Hammer, claw, 14-oz.	1	Limber box, compartment C 2.
Hammer, R.E., telegraph, sledge	1	Off side, limber.
Hook, bill	1	Off side, limber.
Insert, cable	1	Limber box, compartment D.
Jumpers	1	Under footplate of limber.
Ladder, field telegraph	1	Under wagon body
Links, chain, endless, { cranked (spare)	2*	} Limber box, compartment D.
{ ordinary (spare)	2*	
Microphones, capsule	3*	Limber box, compartment D.
Oil, Bangoon pint	1	In oil can.
Pickets, guy, telegraph, light... ..	10	Limber box, compartment C 2.
Pins, earth	9	Limber box, compartment C 1.
Pins, hook, 2nd Class "C" capped wheels... .. (spare)	1	Limber box, compartment B 3.
Pipe, hose, rubber, ½-inch ... feet	6	Limber box, compartment B 1.
Pipe, hose, rubber, ¾-inch ... feet	30	Limber box, compartment D.
Pliers, side cutting, 6-inch ... pairs	10	Limber box, compartment B 4.

* Packed in small wooden box, provided locally.

† According to vocabulary number of wheel in use.

WAGON, TELEPHONE—continued.

Articles.	No.	Where carried.
Poles, telegraph, wood, 17 feet. ...	4	Wagon body, between drums.
Reels, cable, No. 2	2	Wagon body.
Ropes, drag, light, G.S. ... pairs	1	Platform board, limber.
Screens, telephone	3	On footboard of limber.
Solution, rubber, 3-oz. tubes ... tubes	6	Limber box, compartment B 1.
Spade, Mark III	1	Under limber, off side.
Spanner, adjustable, 11-inch	1	Limber box, compartment C 2.
Spanner, No. 184†	1	Limber box, compartment D.
Spindles, reel, cable, No. 2	2	Limber box, compartment B 2.
Spring, catch, drum spindle bearing, wagon, telephone ... (spare)	1*	Limber box, compartment D.
Spring, catch, limber and perch hooks (spare)	1*	" " " "
Spring, seat, wagon, telephone (spare)	1*	" " " "
Sticks, crook, short	1	Top of limber box.
" " long	1	Wagon body, on top of poles.
Strap, winding gear, wagon, telephone (spare)	1	Limber box, compartment D.
Swingletree, No. 11	1	Platform board, limber.
Tape, rubber, pure	6	Limber box, compartment B 2.
Telephone sets, portable D, Mark III	8	Limber box.
Tools, electricians' (and materials for repair)... .. set	1	In hold-all, limber box, compart- ment D.
Washer, drag, 2nd Class "C" capped wheels... .. (spare)	1	Limber box, compartment B 3.
Wire, electric, S. 11, Mark III yards	40	Limber box, compartment D.

* Packed in small wooden box, provided locally.

† Component of vehicle.

DIAGRAM OF PACKING. **Q.F., 4.5-INCH HOWITZER WAGON AND LIMBER.**

LIMBER.

"NEAR" SIDE.

"OFF" SIDE.

- On platform board.*
- | | |
|-----------------------------|------------------------------|
| (c) 1 bar, supporting pole. | 3 ingrs, traces. |
| 1 swingframe. | 1 breastplate. |
| 1 pair traces, artillery. | 2 straps, supporting, front. |
| 2 straps, traces. | 1 strap, supporting, rear. |
| 2 shovels, Q.S. | |

- Under limber.*
- | | |
|---------------------------------|--------------------------------|
| 1 water brush. | 1 oil can, No. 3, mineral oil. |
| 1 grease box, 3 lb. | 1 M.M. hook. |
| 1 oil can, No. 3, kerosene oil. | |

- On top of ammunition bar.*
 Blankets.
 1 ammunition carrier.
On front of ammunition bar.
 2 rifle covers.

3 shrapnel shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.
3 shrapnel shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.

1 spade (on side).

1 spade (on side).

- 6 canvas buckets (in wire net receptacle).
 2 pickaxe (under).
 Key, No. 19 (in pocket on lid).

WAGON.

2 Handspikes, common.

(c) 1 Pole jalousie.

(d) 1 Brush, planks.

- Fittings for two camp kettles (under).*
 Key, No. 19 (in pocket on lid).

3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 shrapnel shell 3 cartridges 3 fuses in this.
3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.
3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.
3 shrapnel shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.	3 H.R. shell 3 cartridges 3 fuses in this.

1 saw, hand, in case (on side).

(c) 1 saw, No. 19 (on side).
 (d) 1 falling axe (on side).

- 1 Indian, fur.
 (c) 1 Line, white. (c) 1 Hammer, fur (in wire net receptacle).

- On top of ammunition bar.*
 Blankets.
 Lamp, slope (in box).
 Pickering rope.
 Ropes, drag, pole.
 (2) Valve, flutes or wheels.
 Valve, horse shoes.
 (2) Valve, soldiers tools.
 (2) Valve, shoeing tools.

NOTE.—Pending the introduction of Observation Vehicles for R.P.A. batteries, temporary arrangements are to be made to carry signalling apparatus which form part of equipments, on top of Wagon Body.

DIAGRAM OF PACKING.

WAGON, TELEPHONE

"Near" side.

LIMBER.

"Off" side.

On platform board—

1 bar, supporting draught pole, No. 3; 1 pair ropes, drag, light, G.S.;
1 swingloose, No. 11; 2 buckets, water, canvas.

On front of box—

3 covers, short rifle.

Under footplate—

1 felling axe; 1 jumper.

On footboard—

Screens, telephone, 3.

1 spade under.

1 water brush.

1 yok axe.

Inside box—

Compartment A.

Cells, electric—

1 inert, 16

1 De. spore, 16

1 galvanometer, de-

1 tector Q. and L., 1

1 Telephone sets, por-

1 table, D 111. 8

Compartment B.

1. Solution, rubber,

1 6 tubes; pipe,

1 hose, rubber,

1 3-in., 8 feet.

2. Tape, rubber,

1 6 oz.; spool,

1 reel, cable No. 2,

1 2.

3. Collar, adjusting,

1 24 Cl., G., 1;

1 pin, 1/2 inch, 1;

1 washer, drag, 1.

4. Pliers, side cut-

1 ting, 10 pairs;

1 guys, telegraph

1 pole, 4.

Compartment C.

1. Apron, lead, 1;

1 glass, carafe, 3.

2. Hammer, claw, 1;

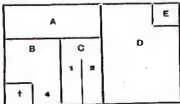
1 saw, 12 in., 1;

1 chain, 1/2 inch, 1;

1 4 shovels; blocks,

1 hooks, F. & T., 2;

1 planks, guy, 10.



† Divided into three compartments.

No. 1, 2 & 3 from rear to front.

1 stick, crook, short.

1 box grease, 3 lb., under.

1 bar carrying drum

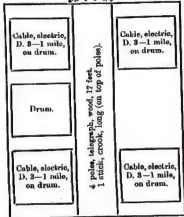
(on top of box, strapped

to back rest).

BODY.



2 reels, cable, No. 2,
each carrying 1
mile of cable,
electric, D. 1.



1 ladder, field telegraph, under.

* Packet in small wooden box provided locally.

† According to vocabulary number of wheel in use.

1 inserter, cable.

1 ball hook.

1 hammer, R. H. 1

1 telegraph, electric.

Inside box—

Compartment D.

Bracket, pawl,

winning gear 11

Calch, drum,

spindle bearing 1*

Rolls, link, chain,

enforce... 3*

Links, chain,

and... 3*

Crack... 3*

Ordinary... 3*

Cordage, spun yarn,

hemp—

1 thread... No. 28

3 thread... 5

Guards, hand,

tel. eq... 2

Pipe, hose, rub-

ber, 1/2 inch, foot 30

Wire, electric,

S. 11... yds, 40

Clip, strap, win-

ing gear... 1*

Spanner, No. 124 1

Spring, catch,

drum spindle 1*

Spring, catch,

finger and

ports hooks... 1*

Herring, seal... 1*

Strap, winding

gear... 1*

Tools, electric

(and

materials for

repair)... set 1

Microphones,

capsule... 3*

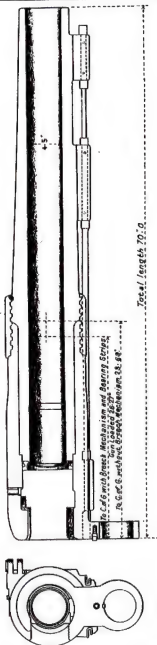
Compartment E.

Can, oil, lubri-

cating... 1

ORDNANCE, Q.F. 4.5 INCH HOWITZER, MARK I.

SCALE=1/10.

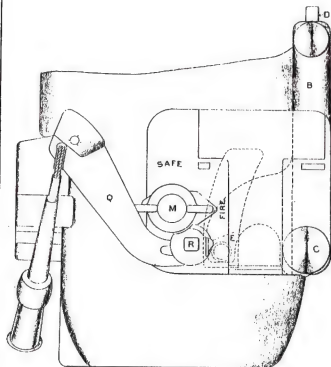


Total length 70.0

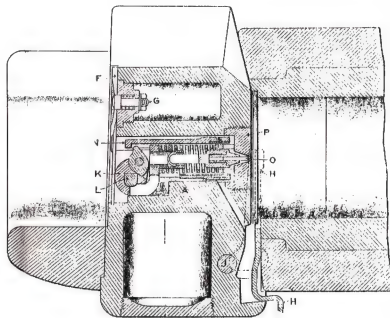
ORDNANCE, Q. F. 4.5 INCH HOWITZER, MARK I.

GENERAL ARRANGEMENT OF BREECH MECHANISM.

SCALE $\pm \frac{1}{3}$.



PLAN.



SECTIONAL PLAN.

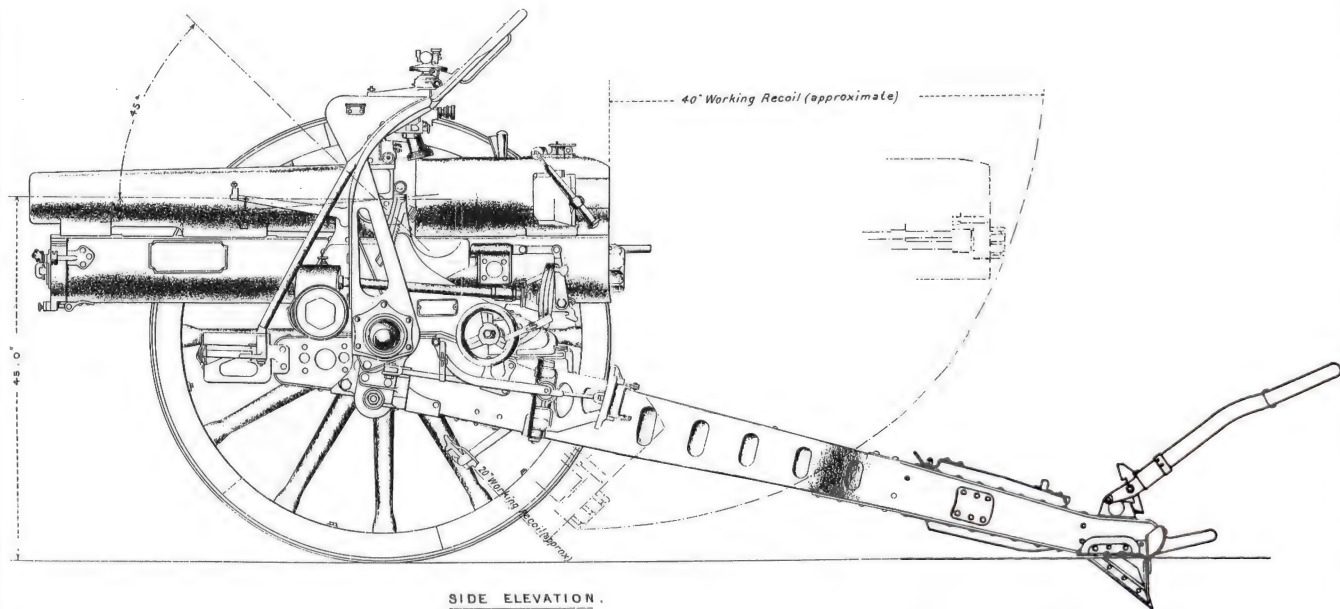
- A. Breech Block.
- B. " Mechanism Lever.
- C. Pin, Axis, B.M. Lever.
- D. Catch, Retaining B.W. Lever.
- E. Cam Plate, B.M. Lever.
- F. Cover Plate.

- G. Catch, Retaining Cover Plate.
- H. Extractor.
- J. Pin, Retaining Extractor.
- K. Firing Lever.
- L. Pin, Actuating Firing Lever.

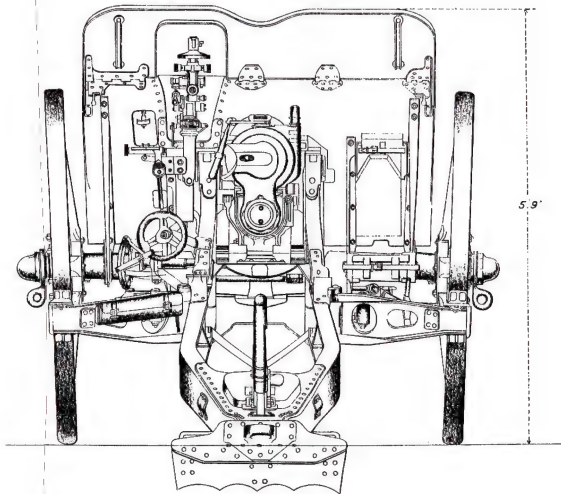
- M. Safety Stop.
- N. Striker.
- O. Firing Pin
- P. " Hole Bush.
- Q. Trigger Lever.
- R. " Bolt.

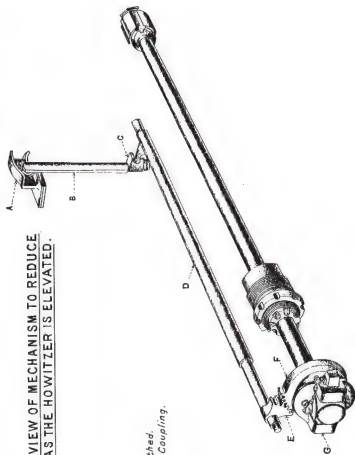
CARRIAGE, FIELD, Q. F. 4.5 INCH HOWITZER, MARK J

SCALE - $\frac{1}{12}$



SIDE ELEVATION.

CARRIAGE, FIELD, Q. F. 4.5 INCH HOWITZER, MARK I.SCALE = 1/12REAR ELEVATION

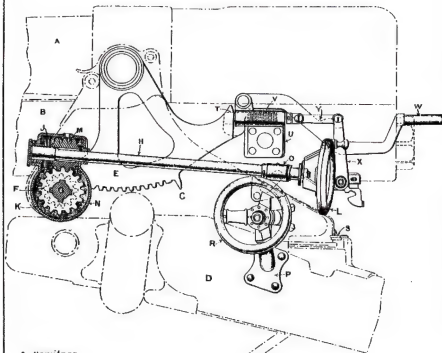


PERSPECTIVE VIEW OF MECHANISM TO REDUCE
THE RECOIL AS THE HOWITZER IS ELEVATED.

- A. Cam.
- B. Bar.
- C. Lever.
- D. Rod.
- E. Arc.
- F. Collar, Toothed.
- G. Piston Rod Coupling.

CARRIAGE, FIELD. Q. F. 4.5 INCH HOWITZER, MARK I.
GENERAL ARRANGEMENT OF ELEVATING TRAVERSING & CRADLE LOCKING, GEARS.

SCALE = $\frac{1}{8}$.



- A. Howitzer.
- B. Cradle.
- C. Saddle.
- D. Trail.

ELEVATING GEAR:-

- E. Arc.
- F. Pinion.
- G. " " Shaft.
- H. Worm Spindle.
- J. Disc Springs.
- K. Worm Wheel.
- L. Hand Wheel.
- M. Worm
- N. " Wheel Bracket with Compressing Nut.

- O. Worm Spindle Bracket.

TRAVERSING GEAR:-

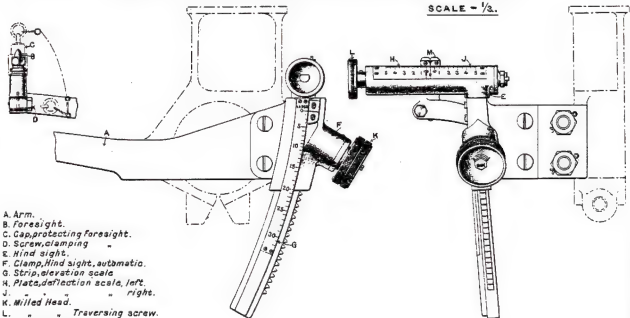
- P. Pivot Bearing Bracket.
- R. Handwheel.
- S. Degree Scale & Pointer.

CRADLE LOCKING GEAR:-

- T. Plunger.
- U. " Bracket.
- V. " Spring.
- W. Hand Lever.
- X. Cranked Lever.
- Y. Connecting Links.

SIGHT, BAR, CARRIAGE, FIELD, Q.F. 4.5 INCH HOWITZER, MARK I.

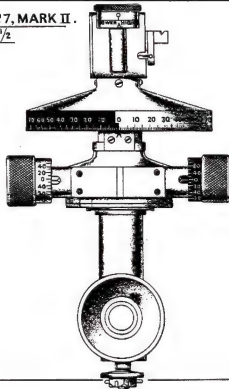
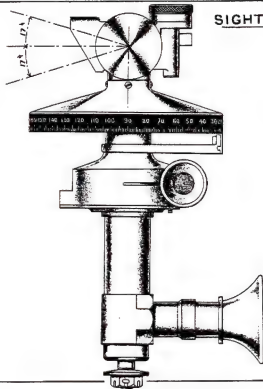
SCALE - $\frac{1}{3}$.



- A. Arm.
- B. Foresight.
- C. Cap, protecting foresight.
- D. Screw, clamping "
- E. Hind sight.
- F. Clamp, Hind sight, automatic.
- G. Strip, elevation scale
- H. Plate, deflection scale, left.
- J. " " right.
- K. Milled Head.
- L. Traversing screw.
- M. Deflection Nut.

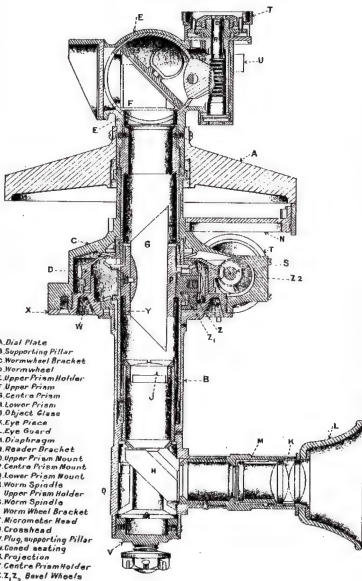
SIGHT, DIAL, N°7, MARK II.

SCALE = 1/2



SIGHT, DIAL, NO 7, MARK I OR II.

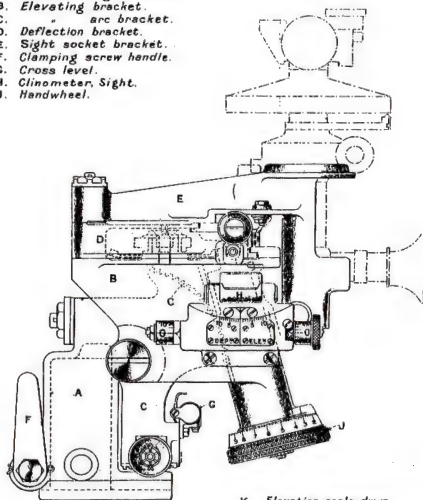
SCALE - 3/4.



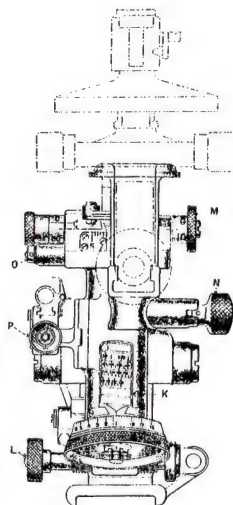
CARRIER, N^o 7 DIAL SIGHT, N^o 1, MARK I.

SCALE - $\frac{1}{8}$.

- A. Reciprocating bracket.
- B. Elevating bracket.
- C. " arc bracket.
- D. Deflection bracket.
- E. Sight socket bracket.
- F. Clamping screw handle.
- G. Cross level.
- H. Clinometer, Sight.
- J. Handwheel.



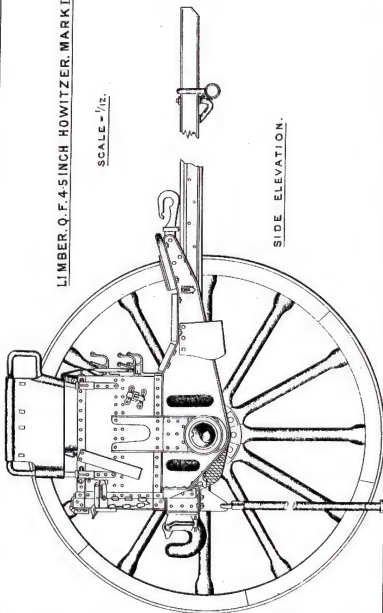
- K. Elevation scale drum.
- L. Cross level adjusting screw.
- M. Deflection traversing screw.
- N. Catch Pin.
- O. Plunger.
- P. Clinometer, sight, actuating screw.

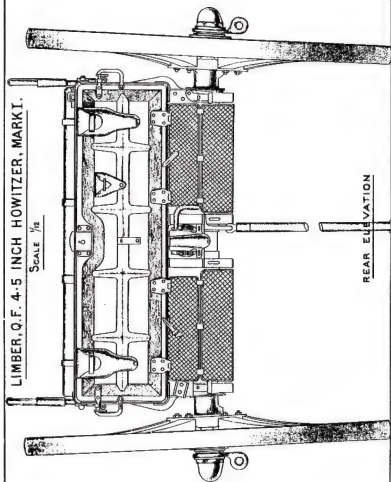


LIMBER, Q. F. 4.5 INCH HOWITZER, MARK I.

SCALE - 1/12.

SIDE ELEVATION.





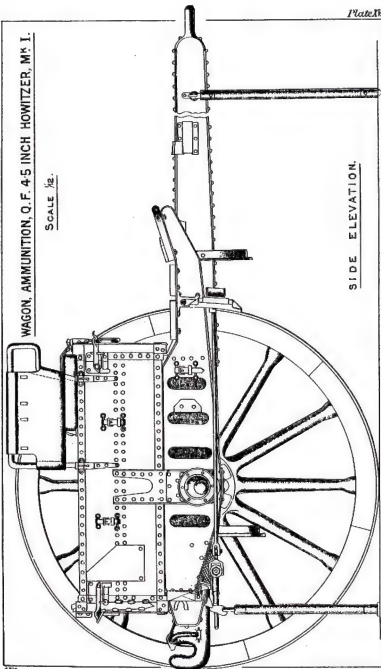
LIMBER, Q.F. 4.5 INCH HOWITZER, MARK I.

SCALE $\frac{1}{12}$

WAGON, AMMUNITION, Q.F. 4.5 INCH HOWITZER, MK. I.

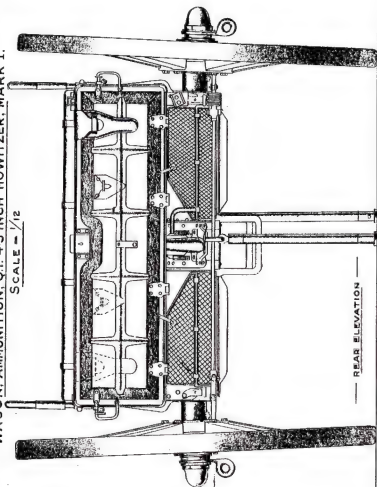
SCALE $\frac{1}{32}$.

SIDE ELEVATION.



WAGON, AMMUNITION, Q.F. 4.5 INCH HOWITZER, MARK I.

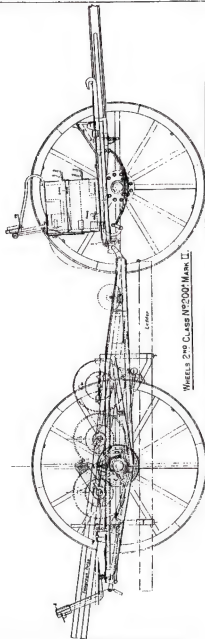
SCALE = $\frac{1}{12}$



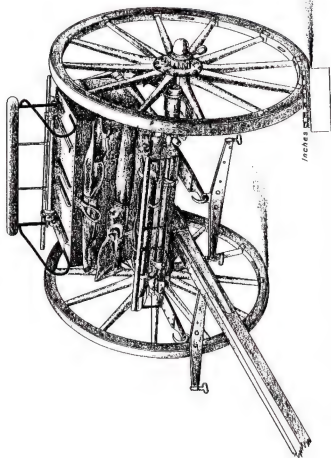
— REAR ELEVATION —

WAGON, TELEPHONE. (MARK II.)

SCALE $\frac{1}{32}$.

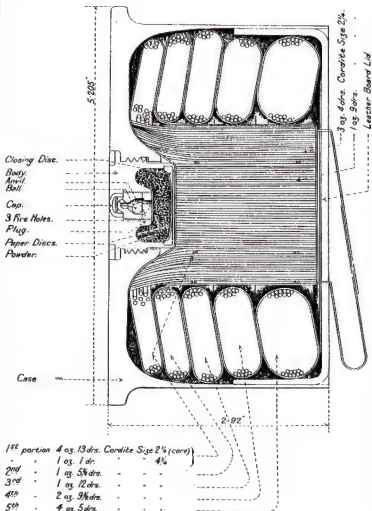


WAGON, TELEPHONE, (MARK I).



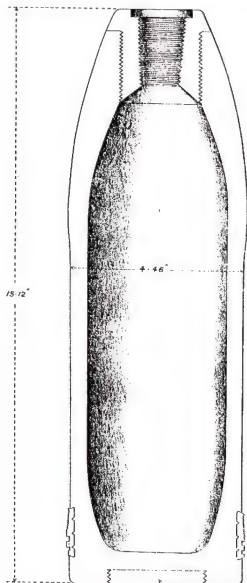
CARTRIDGE, Q.F. 4.5 INCH HOWITZER, FILLED 15 OZ.
14 DRS. CORDITE, M.D. SIZES $4\frac{1}{4}$ AND $2\frac{1}{4}$. MARK I.

Scale = $\frac{1}{16}$.



SHELL, Q. F. HIGH EXPLOSIVE, 4.5 INCH HOWITZER, M^K II.

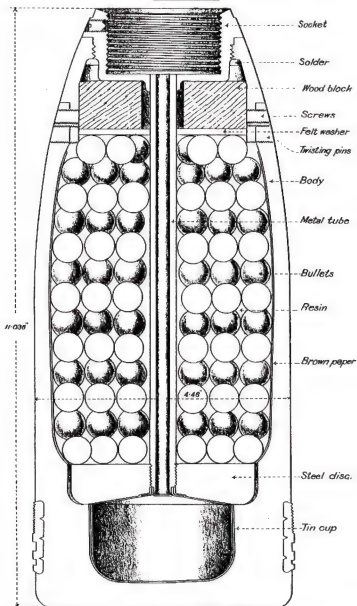
SCALE - $\frac{1}{2}$.



Steel Plate Disc.

SHELL, Q.F. SHRAPNEL 4.5 INCH HOWITZER, MARK I.

SCALE = $\frac{3}{4}$.



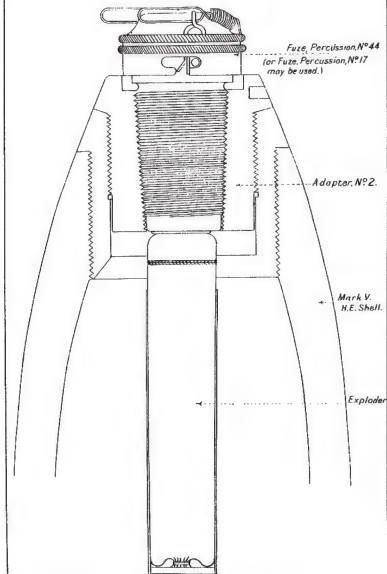
FUZE, PERCUSSION, D. A. WITH CAP, N° 17, MARK III.

SCALE = $1\frac{1}{4}$.



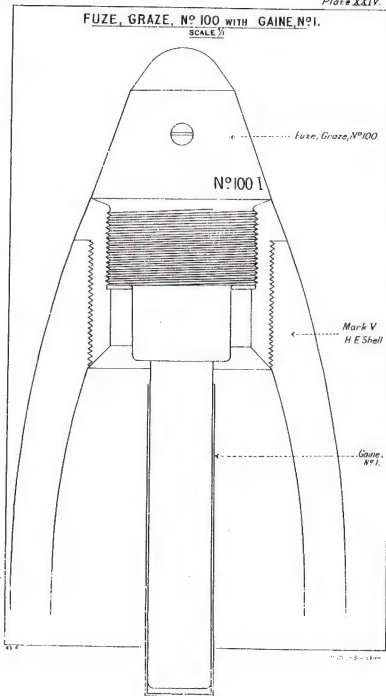
FUZE, PERCUSSION, D.A. WITH CAP. N° 44

SCALE $\frac{1}{16}$.

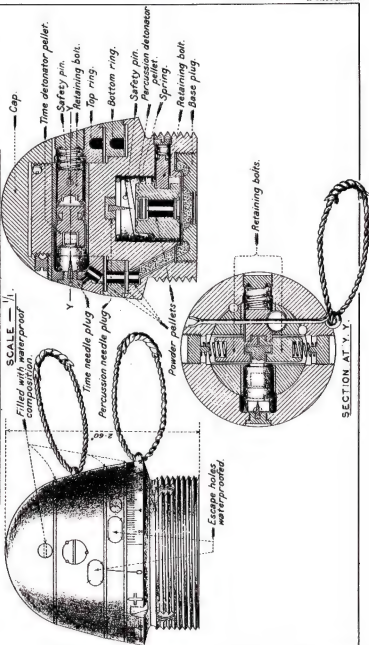


FUZE, GRAZE, N° 100 WITH GAINÉ, N° 1.

SCALE $\frac{1}{2}$



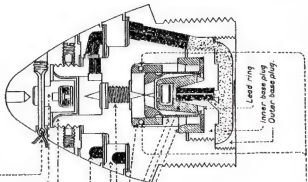
FUZE, TIME AND PERCUSSION, N° 82, MARK III.



FUZE, TIME AND PERCUSSION, No 86.

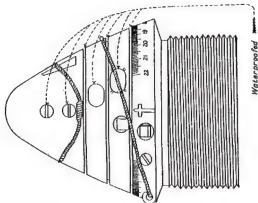
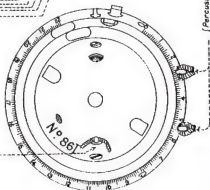
SCALE 1/2

Time safety pin.
Time detonator pellet.
Four winged spring.
Top composition ring.
Bottom.
Needle.
Safety ring.
Bulge cage.
Percussion detonator pellet.
Distance ring.



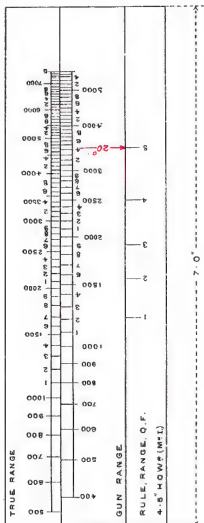
Lead ring
Inner base plug
Outer base plug

Percussion
Safety Pin



RULE, RANGE, Q.F. 4.5 INCH, HOWITZER, MARK I.

SCALE = $\frac{1}{1}$.



INDICATOR, FUZE, Q.F. 4-5 IN. HOWITZER, MARK I.

SCALE $\frac{1}{4}$.

